DT-4

# DEVELOPMENT PLAN

# FOR

# COAL PRODUCTION INCREASEMENT

AUGUST 1961

Planning Division

Dai Han Coal Corporation

DT-4

# D E V E L O P M E N T  P L A N

# F O R

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# I N D E X

# CHAPTER I INTRODUCTION

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Without improvement of our nation's coal industry as the major source of energy economy, the reconstruction of national economy can not be achieved. In the year of 1958, the government has established 8 year coal production increasement plan and has been exerting for the practice. However due to the political and social confusion of last two years, adequate policy on coal production increasement could not been pursued vigorously. Thus shortages in coal supply can not be avoided for four years from now on.

Since the Military Coup d'etat of May 16, 1961, a possitive national policy to restrict the fuel use of forestry products has been enforced and thereby schemed this 5 year coal production increasement plan (from 1962 to 1966) by re-studying the previous 8 year coal production increasement plan. This very plan is identical with the Government's 5 year coal production increasement programe which has been approved by the Overal Economic Reconstruction Planning Committee of the Supreme Council for National Reconstruction and by the Ministry of Commerce and Industry. This Plan is frammed upon the following basis.

1. The previous 8 year plan estimated the anthracite demand of 1962 as 6,410,000 tons and of 1966 as

9,980,000 tons. But this plan anticipates the anthracite demand of 1962 as 6,890,000 tons and of 1966 as 11,850,000 tons taking the reliable forecastings of national vital statistics, the changes in the Government's power generating programe and the restriction in fuel use of forestry products into condiderations.

2. In the year of 1960, national anthracite production was 5,350,000 tons of which 2,576,099 tons from Dai Han Coal Corporation mines and the rest or 2,773,901 tons from private mines. At all events, 50 % of private mine's output is being produced through conventional or rather primitive mining method. Therefore, the production capacity of private mines will be in the neigh-borhood of 2.7 million tons per annum. In some instances, it is expected to reduce rapidly unless the coal selling price is boosted. On the other hand, the Dai Han Coal Corporation will be producing 4.2 million tons annually within the mining areas. The increased production will scarecely realized due to the shortages in mining areas to develop.

3. If the private mines will cease the petty mining and participate for the large scale development by financial and technical assistances of the Government, the required anthracite could be produced in due time when the production from private mines droop. What is more, only such step will prevent the raise of coal selling price. In spite of rendering all the possible cooperation by the Government the development is delayed or the national anthracite requirement could not be met or cause unstable in national economy by boosting the coal selling price and helping inflation because of unsincerity of the propreitors, then the Government will have to take s strong action and enforce the development.

4. In the forementioned prospects, the Coal Mines Development Acceleration Law and the revised Dai Han Coal Corporation Organic Law must be legislated in order to insure the large scale development of private mines and the adequate coporation of the Government. This 5 year plan is made under such premises.

5. This plan schemes 5,880,000 tons of coal production in 1962 and 11,740,000 tons in 1966. The Dai Han Coal Corporation mines are assigned 3,180,000 tons in 1962

and 4,200,000 tons in 1966.

6. The Samchuck area where test drillings are fairly progressed is frammed as the primary object to develop and the Jungsun coal field, Kangnung coal field, Munkyung coal field of Kyungbuk, and Hwasun coal field of Junnam are considered as the secondary object because the necessary geological exploration has not been done.

7. For the coal fields development, transmission line layout and railroad facilities must be furnished up to each development base under the responsibility of the Governement. Besides, coal wagons and ships procurement, enlargement of ports facilities, and construction of machineries and electric equipments manufacturing factory for coal mines will also have to be accomplished.

8. As to the investment, Dai Han Coal Corporation requires $ 9,259,000 of dollar cost and Hw 12,799 million of local hwan cost while private mines require $ 30,275,000 of dollar cost ($ 3.25 per ton of annual production) and Hw 51,807 million of local hwan cost (Hw 5,525 per ton of annual production). The dollar cost requirement

both for Dai Han Coal Corporation and private mines will have to be financed by a foreign credit facility. All of hwan cost requirement for Dai Han Coal Corporation could be alloted by the own source of fund.

9. However, one half of the local fund requirement for private mines will have to be covered on a loan basis and the rest of the amount must come from their own source of fund by issuing stocks. The stock of private mines will be under suitable legal warrant. In the hwan cost requirement forementioned, amount for the custom duties and other various taxes for the importing foreign materials are excluded since it is subject to an examption. The foreign long-term credit is assumed to be awarded on 10 year credit basis after the signing of each contract and the payments will not be effected until the 1st shipment of equipments ordered or two years after the signing of the contract. Therefore, after two years signing the contract, annual installment of $\frac{1}{8}$ of the principal will be payable. Interests of 6 % per annum will have to be paid on the balance each year. For the redemption of the long term credit, a half million tons average per year of anthracite is required to export to a foreign country

to secure necessary foreign exchange. This anthracite exportation will have to be proceeded positively even cutting down the domestic anthracite consumption if necessary.

10. The supporting projects such as, transmission line layout, railroad construction, coal wagons and ships procurement and enlargement of ports facilities will eventually be constructed. This supporting projects will require $ 61,470,000 of dollar cost and Hw 28,863 million of local hwan cost. All the details and cost estimates for the supporting projects will have to be re-cheched by the Government. However, important thing is that these supporting projects must be pursued in suitable time prior to the coal mines development,

## CHAPTER II OUTLOOK ON FUTURE ENERGY AND ANTHRACITE DEMAND

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## CHAPTER II OUTLOOK ON FUTURE ENERGY & ANTHRACITE DEMAND

### 1. Introduction

This Chapter is devoted for the anticipation of future energy and anthracite demand in order to measure the theoretical production scale.

There are many approaches to estimate future economic trend. However, long-term forecasting based on statistical analysis has been proved as the most favorable practice in many cases.

Therefore, we have forecasted the future trend of energy and anthracite demand up to the year of 1966 by the statistical study with Industrial Production Index as well as the population which, we consider, are related most closely in our study than any others.

At the present time, anthracite, bituminous coal, hydraulic power, fuel oil and wood and straw could be considered as the sources of energy in South Korea. However, as to the wood and straw consumption, no information is available in any degree of reliability. Hence, we have excluded the wood and straw consumption in our study.

Furthermore, the Korean Economy since World War II, never had a sound economic development due to the Korean War except recent

few years. By all means, it is an adventure to estimate future state solely based on past performances of 6 to 7 years. But, since there is no other way, under the assumption that the Korean economy must at least be developed in future at the rate of past 6 to 7 years' growth, this study which must be accomplished has been undertaken.

2. Energy Supply in the Past

The result of past 14 years energy supply, from 1947 to 1960, are shown on the Table No. 1, and its equivalent value to the 5,300 Cal. anthracite are shown in Table No. 2. The graphic presentation of Table No. 2 is shown in Fig No. 1.

As you see, the total energy supply excluding wood and straw consumption in 1947 was only 1,768,000 tons but it was boosted up to 7,436,000 tons or roughly 4.2 times in 1960. Especially, anthracite supply which was only 26.2 % of total energy in 1947, occupied 72 % of all energy in 1960. If we lock at the tons increased, it goes from 463,000 tons in 1947 to 5,350,000 tons in 1960 or it is improved more than 10 times.

Hydraulic power and fuel oil supplies show a steady increase while imported bituminous coal supply shows a decrease to 3.5 % of total energy consumed in 1960 from its maximum peak of 63.4 % in 1951.

## PAST ENERGY SUPPLY

Table No. 1

| Year | Hydraulic Power | Anthracite | Bituminous Coal | Fuel Oil | Barges |
|---|---|---|---|---|---|
| | $10^3$ KWH | $10^3$ Tons | $10^3$ Tons | $10^3$ Gal. | $10^3$ KWH |
| 1947 | 208,478 | 463 | 690 | 43,693 | - |
| 1948 | 242,119 | 800 | 958 | 63,961 | 8,336 |
| 1949 | 202,251 | 1,066 | 660 | 73,396 | 132,613 |
| 1950 | 97,026 | 634 | 219 | 31,605 | 64,289 |
| 1951 | 58,688 | 162 | 753 | 30,917 | 190,051 |
| 1952 | 233,739 | 577 | 756 | 39,721 | 231,519 |
| 1953 | 394,536 | 867 | 679 | 75,878 | 221,751 |
| 1954 | 513,241 | 889 | 901 | 76,015 | 265,502 |
| 1955 | 478,064 | 1,308 | 1,065 | 89,587 | 214,443 |
| 1956 | 517,018 | 1,805 | 973 | 149,611 | - |
| 1957 | 419,253 | 2,441 | 742 | 148,472 | - |
| 1958 | 614,241 | 2,671 | 700 | 170,696 | - |
| 1959 | 778,948 | 4,136 | 58 | 213,521 | - |
| 1960 | 580,001 | 5,350 | 208 | 208,120 | - |

Sources: The Bank of Korea, "Monthly Statistical Review"

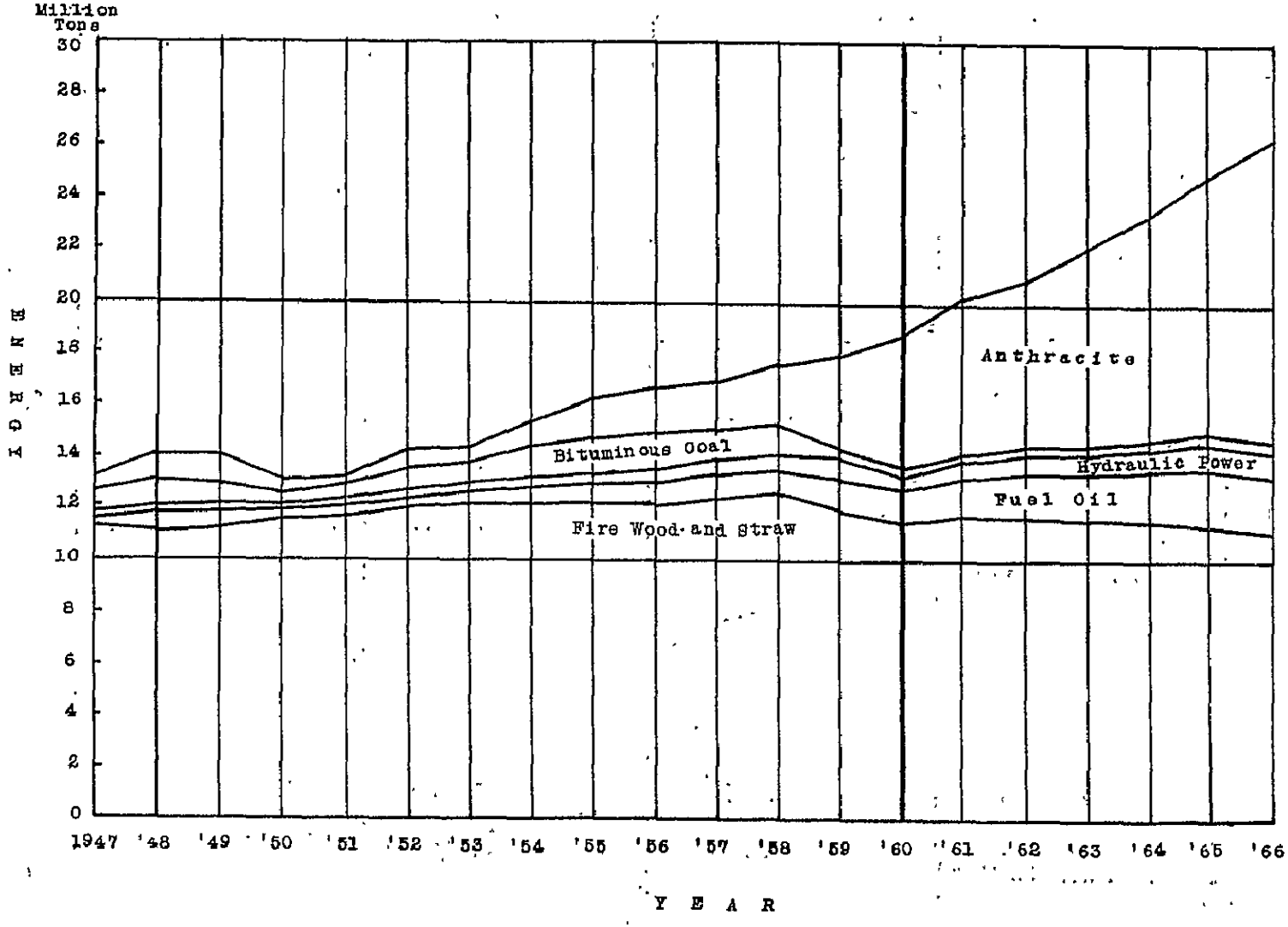
The M.C.I., "Coal Statistics in Korea"

# ANALYSIS OF ENERGY DEMAND

Table No. 2

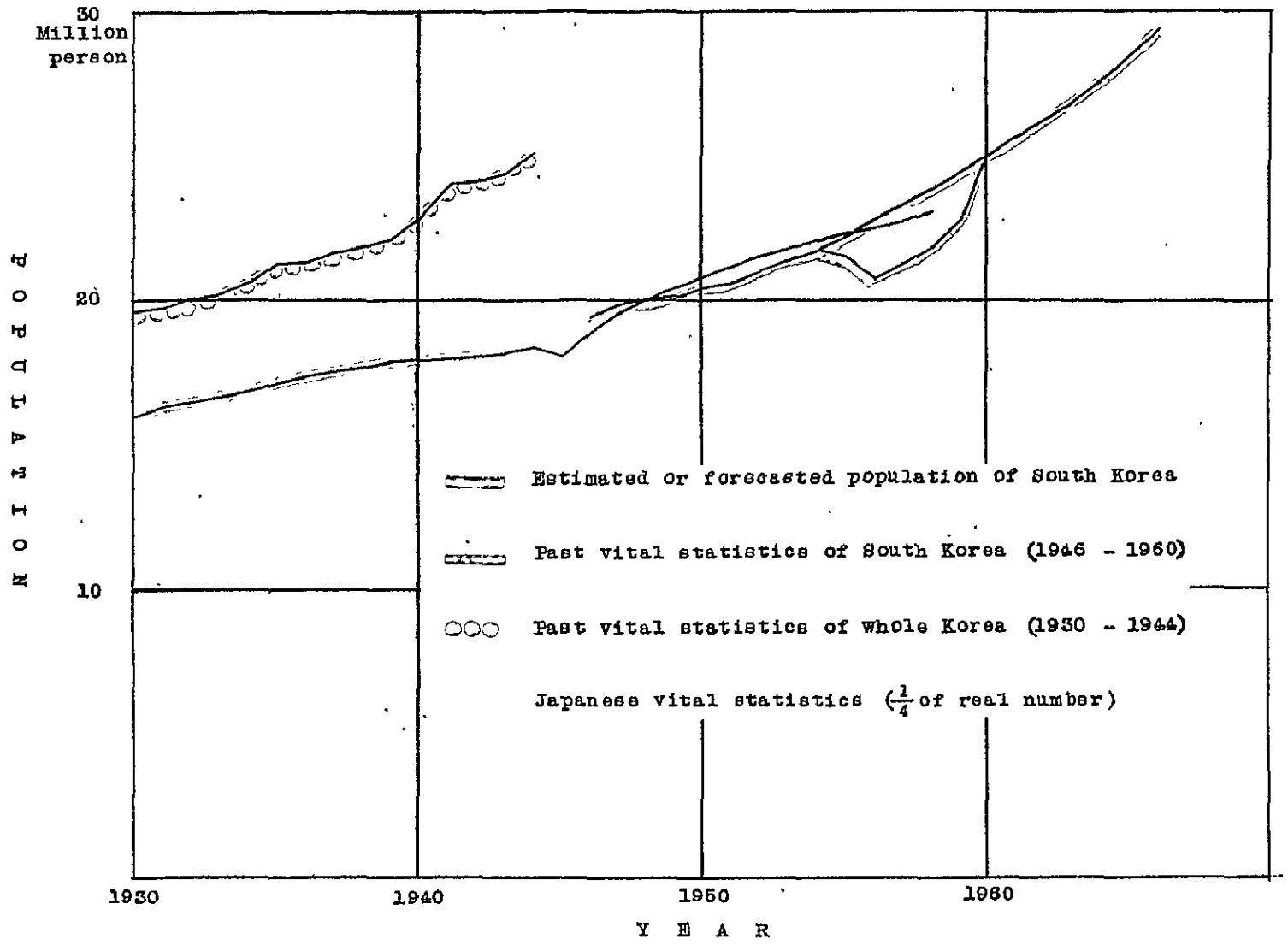
| Years | S | | H | | F | | B | | A | | T | | P | E | I |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Barge | | Hydraulic Power | | Oil | | Bituminous Coal | | Anthracite | | All Energy | | Population | Per Capita Energy Consumption | Industrial Production Index |
| | Anthracite Equivalent 1000 T | % | Anthracite Equivalent 1000 T | % | Anthracite Equivalent 1000 T | % | Anthracite Equivalent 1000 T | % | Actual Value 1000 T | % | Anthracite Equivalent 1000 T | % | Person | Kg/P | '68=100 |
| 1947 | | - | 141 | 8.0 | 301 | 17.0 | 863 | 48.8 | 463 | 26.2 | 1,768 | 100 | 19,886,234 | 88.9 | |
| 1948 | 5.6 | 0.2 | 164 | 6.3 | 441 | 16.9 | 1,197 | 45.9 | 800 | 30.7 | 2,608 | 100 | 20,027,393 | 130.2 | |
| 1949 | 90 | 3.4 | 137 | 5.2 | 506 | 19.3 | 825 | 31.5 | 1,066 | 40.6 | 2,624 | 100 | 20,188,641 | 129.9 | |
| 1950 | 93.5 | 3.5 | 65.7 | 5.3 | 218 | 17.7 | 274 | 22.2 | 634 | 51.3 | 1,235 | 100 | 20,512,899 | 61.9 | |
| 1951 | 128 | 8.6 | 39.8 | 2.7 | 213 | 14.4 | 941 | 63.4 | 162 | 10.9 | 1,484 | 100 | 20,670,848 | 17.8 | |
| 1952 | 187 | 7.5 | 158 | 7.5 | 273 | 12.9 | 945 | 44.8 | 577 | 27.3 | 2,110 | 100 | 21,144,210 | 99.7 | |
| 1953 | 143 | 5.4 | 257 | 10.0 | 529 | 19.9 | 849 | 32.0 | 867 | 32.7 | 2,649 | 100 | 21,440,229 | 123.6 | |
| 1954 | 179 | 6.8 | 347 | 11.3 | 524 | 17.1 | 1,126 | 36.8 | 889 | 29.0 | 3,065 | 100 | 21,796,137 | 140.6 | 54.3 |
| 1955 | 145 | 3.9 | 324 | 8.7 | 618 | 16.6 | 1,331 | 35.7 | 1,308 | 35.1 | 3,726 | 100 | 22,200,000 | 167.8 | 64.3 |
| 1956 | | | 351 | 8.0 | 1,030 | 23.4 | 1,216 | 27.6 | 1,805 | 41.0 | 4,402 | 100 | 22,700,000 | 193.9 | 78.6 |
| 1957 | | | 285 | 6.1 | 1,023 | 21.9 | 927 | 19.8 | 2,441 | 52.2 | 4,676 | 100 | 23,260,000 | 201.1 | 90.7 |
| 1958 | | | 417 | 8.1 | 1,176 | 22.9 | 875 | 17.0 | 2,671 | 52.0 | 5,137 | 100 | 23,800,000 | 215.8 | 100.0 |
| 1959 | | | 529 | 8.5 | 1,471 | 23.6 | 73 | 1.2 | 4,136 | 66.7 | 6,209 | 100 | 27,700,000 | 254.4 | 114.7 |
| 1960 | | | 394 | 5.2 | 1,432 | 19.3 | 260 | 3.5 | 5,350 | 72.0 | 7,436 | 100 | 24,994,117 | 297.5 | 125.3 |
| 1961 | | | 466 | 5.6 | 1,691 | 20.4 | 200 | 2.4 | 5,953 | 71.6 | 8,310 | 100 | 25,571,000 | 325 | 137.6 |
| 1962 | | | 488 | 5.2 | 1,854 | 19.6 | 200 | 2.1 | 6,888 | 73.1 | 9,430 | 100 | 26,206,000 | 360 | 149.6 |
| 1963 | | | 510 | 4.8 | 2,017 | 18.9 | 200 | 1.9 | 7,923 | 74.4 | 10,650 | 100 | 26,901,000 | 396 | 161.5 |
| 1964 | | | 532 | 4.4 | 2,180 | 18.4 | 200 | 1.6 | 9,083 | 75.6 | 12,000 | 100 | 27,654,000 | 434 | 173.5 |
| 1965 | | | 554 | 4.1 | 2,343 | 17.4 | 200 | 1.5 | 10,586 | 77 | 13,500 | 100 | 28,466,000 | 474 | 185.5 |
| 1966 | | | 576 | 3.9 | 2,506 | 16.6 | 200 | 1.3 | 11,858 | 78.2 | 15,140 | 100 | 29,336,000 | 516 | 197.4 |

(Fig No.1) PAST ENERGY SUPPLY AND FORECASTED FUTURE ENERGY DEMAND



(Fig No.2)

# VITAL STATISTICS



## 3. Population Forecasting

First of all, we have to know the trend of our vital statistics in order to do any forecasting at all. Therefore, with the past 13 years vital statistics which could be seen in the "Economic Statistics Year-Book" of the Bank of Korea, we have calcualted a curvilinear regression function as follows:

$$Yc = 21{,}054 + 194.5\ (X - 1954) + 29.4\ (X - 1954)^2 \ldots\ldots (P)$$

where; Yc = Population in 1,000 person

X = Year

However, the above regression function will only be effective when the statistics used are adequately represent the universe. Otherwise, it does not mean anything at all. As it could be noticed in Fig No. 2, vital statistics between the years 1955 to 1959 shows a peculiar trend which could never be seen in any other case of vital statistics. It does not of course reasonably agree neither with the statistics of Korea before 1945 nor with the result of 1960 year-end population investgation done by the Ministry of Home Affirs for the purpose of preparing a Census. It could only be considered as biased. Accordingly, the population estimates for 1961 by the above curvilinear regression function came out with smaller figure than the actual population accounted in the end of 1960. Therefore, to bring up the regression function (P) into realization, the Y-intercept "a" was

adjusted by the difference between the actual population of 1960 and the estimated population for 1960 by the equation (P). Now, the revised regression function becomes:

$$Yc = 22,769 + 194.5\ (X - 1954) + 29.4\ (X - 1954)^2 \ldots (P')$$

The biased vital statistics between the years 1955 to 1959 inclusive was also adjusted as follows:

| | |
|---|---|
| 1955 | 22,200,000 |
| 1956 | 22,700,000 |
| 1957 | 23,250,000 |
| 1958 | 23,800,000 |
| 1959 | 24,400,000 |

Thus, the adjusted figures are entered in the (P) column of Table No. 2 and can be graphed as a smooth curve shown in Fig No. 2.

4. Industrial Production Index

The Bank of Korea's new Industrial Production Index using the 1958 as the base year are shown on Table No. 2. If we assume that the growing rate of past years will apply in future, then by the method of least square the following linear regression function (I) could be calculated.

$$Yc = 89.7 + 11.97\ (X - 1957)\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(I)$$

where; Yc = I.P.I. (1958 = 100)

x = Year

To see whether the index estimates by the above equation (I) could represent the universe, we have measured the discrepacies between observed frequencies (the actual I.P.I. of B.O.K.) and the theoretical frequencies (Yc). With this method of measurement of discrepancies what we call Chi Square, we have found out that there is no significant difference between those two frequencies forementioned. Thus, we have concluded that the function (I) is fairly representing the trend of I.P.I. and applied the future index estimates in column (I) of Table No. 2.

5. Per Capita Energy Consumption

The per capita energy consumption is an index to measure a nation's level of industrial civilization. As shown on Table No. 2, the per capita energy consumption of our country in 1960 was approximately 0.3 tons. If we allow 100 % for the energy consumed other than we have listed in this study namely, wood straw or any other form of energy, the total energy consumed will only be 0.6 tons per person. This is still far below with that of other major

countries of the world and this shows us that the level of Korean energy consumption needs a tremendous growth to catch up with other nation. The per capita energy consumption on (E) column of Table No. 2 is arrived simply dividing the total energy consumed by the population. For the purpose of anticipating the future energy consumption, we have used a multiple correlation between dependent variable - past record of per capita energy consumption thus calculated - and two independent variables - the time and the industrial production index which the equation appears as follows:

$$Yc = 117.55 + 0.9925\ X_1 + 14\ (X_2 - 1957) + 0.95\ (X_2 - 1957)^2 \ldots . (E)$$

where; Yc = Per capita energy consumption Kg/person.

$X_1$ = I.P.I.

$X_2$ = Year

## 6. Expected Future Energy Demand

The future energy demand could be estimated by applying all the equations we have been calculated. Multiplying population estimates by regression function (P) to the per capita energy consumption by equation (E), we will have the estimated energy demand excluding wood and straw energy from 1961 to 1966 as shown in (T) column of Table No. 2 and on Fig. No. 1. It is interesting to notice that the energy

required by 1966 will roughly be 15 millions of ton or an increase of 100 percent compared with that of 1960 which was about 7.4 million tons. This implies that the annual rate of increase will be approximately 12.6 percent. Thus calculated energy demand was further analysed by its sources and the anthracite requirement by its sources of consumptions.

## 7. Electric Power Demand Forecasting

Table No. 3 shows the forecast of the total electric power in Korea by its sources of generation. It could be expressed in graph as shown in Fig No. 3.

First, with correlation between past 11 years' total power generated in KWH and time, the following curvilinear regression function could be obtained.

$$Yc = 997 + 143\ (X - 1955) + 2.8\ (X - 1955)^2 \ldots\ldots\ldots (H_1)$$

where; Yc = Total power demand in million KWH

X = Year

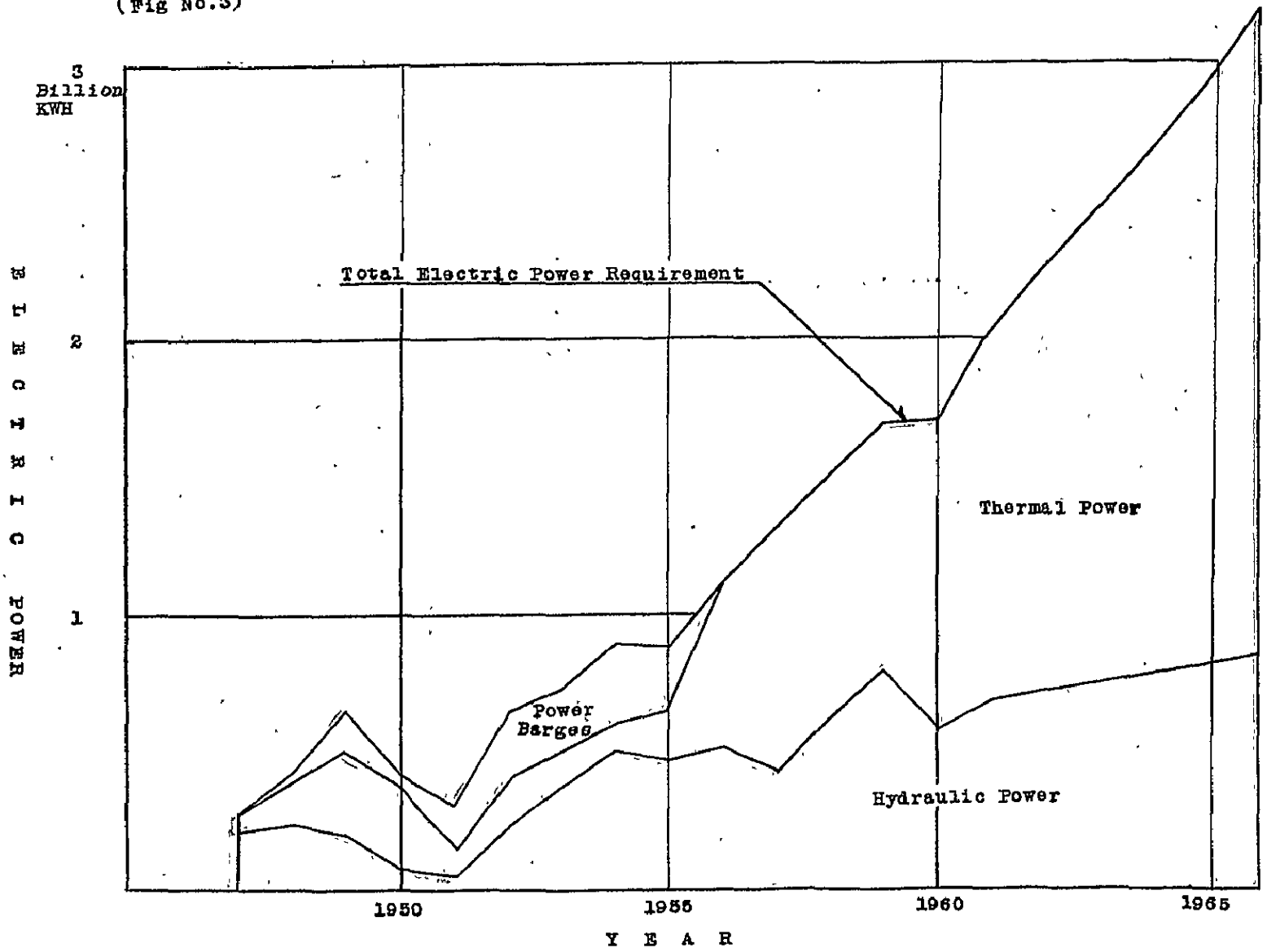
But, as a matter of expecting accuracy, past 7 years' per capita electric power consumption were calculated in order to anticipate the future per capita electric power consumption as we did in Section 5. The following $(H_2)$ is the equation function thus obtained.

Table No.3 FORECASTINGS OF ELECTRIC POWER REQUIREMENTS

| Year | Total Electric power | Hydraulic Power | | | Thermal Power | | | Barge | |
|---|---|---|---|---|---|---|---|---|---|
| | $10^3$ KWH | $10^3$ KWH | % | Anthracite Equivalent 1000 T | $10^3$ KWH | % | Anthracite Equivalent 1000 T | $10^3$ KWH | % |
| 1947 | 276,940 | 208,478 | 75.2 | 141 | 68,462 | 24.8 | 46.5 | - | |
| 1948 | 414,955 | 242,119 | 56.3 | 164 | 164,500 | 39.5 | 122 | 8,336 | 2.2 |
| 1949 | 654,969 | 202,251 | 30.9 | 137 | 320,105 | 48.8 | 217 | 132,613 | 20.3 |
| 1950 | 420,651 | 97,026 | 23.1 | 65.7 | 259,336 | 61.6 | 176 | 64,281 | 15.3 |
| 1951 | 336,629 | 58,688 | 17.4 | 39.8 | 87,909 | 26.2 | 59.7 | 190,031 | 56.4 |
| 1952 | 639,676 | 233,739 | 36.6 | 158 | 174,418 | 27.2 | 118 | 231,519 | 35.7 |
| 1953 | 736,065 | 394,536 | 53.5 | 267 | 129,798 | 17.7 | 88.2 | 211,731 | 28.8 |
| 1954 | 899,096 | 513,241 | 57.1 | 347 | 120,353 | 12.3 | 81.7 | 265,502 | 30.6 |
| 1955 | 879,272 | 478,064 | 53.8 | 327 | 186,765 | 21,3 | 127 | 214,443 | 24.9 |
| 1956 | 1,118,308 | 517,019 | 46.8 | 351 | 601,289 | 53.2 | 408 | - | |
| 1957 | 1,323,013 | 419,253 | 32.1 | 285 | 903,760 | 67.9 | 614 | - | |
| 1958 | 1,511,674 | 614,243 | 40.6 | 417 | 897,431 | 59.4 | 610 | - | |
| 1959 | 1,686,237 | 778,948 | 46.2 | 529 | 907,289 | 53.8 | 616 | - | |
| 1960 | 1,696,951 | 580,001 | 34.2 | 394 | 1,116,950 | 65.8 | 758 | | |
| 1961 | 2,043,000 | 687,000 | 33.5 | 466 | 1,356,000 | 66.5 | 892 | | |
| 1962 | 2,256,000 | 719,000 | 31.8 | 488 | 1,537,000 | 68.2 | 1,042 | | |
| 1963 | 2,470,000 | 751,000 | 30.4 | 510 | 1,719,000 | 69.6 | 1,165 | | |
| 1964 | 2,698,000 | 783,000 | 29.0 | 532 | 1,915,000 | 71.0 | 1,298 | | |
| 1965 | 2,938,000 | 816,000 | 27.8 | 554 | 2,122,000 | 72.2 | 1,438 | | |
| 1966 | 3,190,000 | 848,000 | 26.6 | 576 | 2,342,000 | 734 | 1,587 | | |

# FORECASTINGS OF ELECTRIC POWER REQUIREMENTS

(Fig No.3)



$$Yc = 55.3 + 7\ (X - 1957) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (H_2)$$

where; Yc = Per capita electric power consumption KWH

X = Year

The above $(H_2)$ will enable us to estimate the future per capita electric power consumption from which we can deliver the future total electric power demand by simple multiplication with population forecasted. The future electric power requirements obtained through functions $(H_1)$ and $(H_2)$ were meaned, to get the both elements into consideration.

The growing rate of hydraulic power were expressed by the method of simple correlation as $(H_3)$ from the relation with industrial production index.

$$Yc = 315 + 2.7\ X \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (H_3)$$

where; Yc = Hydraulic power demand in million KWH

X = I.P.I.

With the above equations $(H_1)$, $(H_2)$ and $(H_3)$ the total electric power demand in future and the hydraulic power requirements, as shown on Table No. 3 were calculated. The hydraulic power demand were subtracted from the total power to get the thermal power requirements, because the electricity from generating barges will be expressed in other terms of energy such as fuel oil or bituminous

coal whatever it requires for it's fuel. The estimated hyraulic power on Table No. 3 were converted to 5,300 Cal. anthracite equivalent for the purpose of adapting in (H) column of Table No. 2. By this, we can calculate the percentages that hydraulic power will occupy in the estimated future energy requirements.

8. Imported Fuel Oil

The fuel oil demand in future is expected to be increased because of its special use in automobiles, ships and locomotives. If we assume the demand will be kept at the growing rate of past 7 years, the following linear regression function (F) could be obtained.

$$Yc = 1{,}039 + 183\ (X - 1957) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (F)$$

where; Yc = Fuel oil demand in 1,000 tons of anthracite equivalent

X = Year

The anticipated future fuel oil demand by this (F) are shown in (F) column of Table No. 2.

9. Imported Bituminous Coal

As you can see in (B) column of Table No. 2, supply of imported bituminous coal is diminishing every year. But, it will be

fixed to, at least, 200,000 tons per year as minimum requirement because of it's special usages.

10. Future Demand of Anthracite

All other energy except anthracite demand in future have been calculated. Now the future anthracite requirements could be easily anticipated by subtracting hydraulic power, fuel oil and bituminous coal requirements from the total energy estimated. Final analysis of future energy demands are shown on Table No. 2 and on Fig No. 1.

The analysis of anthracite requirements which directly related to Dai Han Coal Corporation will be discussed further in the followings. The anthracite requirements could be classified as Military use, Government use, Railroads use, Power Plants and Industrial use, and Civilian use by it's categories of consumption. Supplied anthracite of past 6 years categorized by the forementioned uses are shown in Table No. 4.

The future anthracite demand for Military use, Government use, and Railroads use are fixed by the figures estimated by the Government because it have been calculated by considering the future military forces and number of personnel required in the future Government and by the plan to exchange the fuel for locomotives to diesel

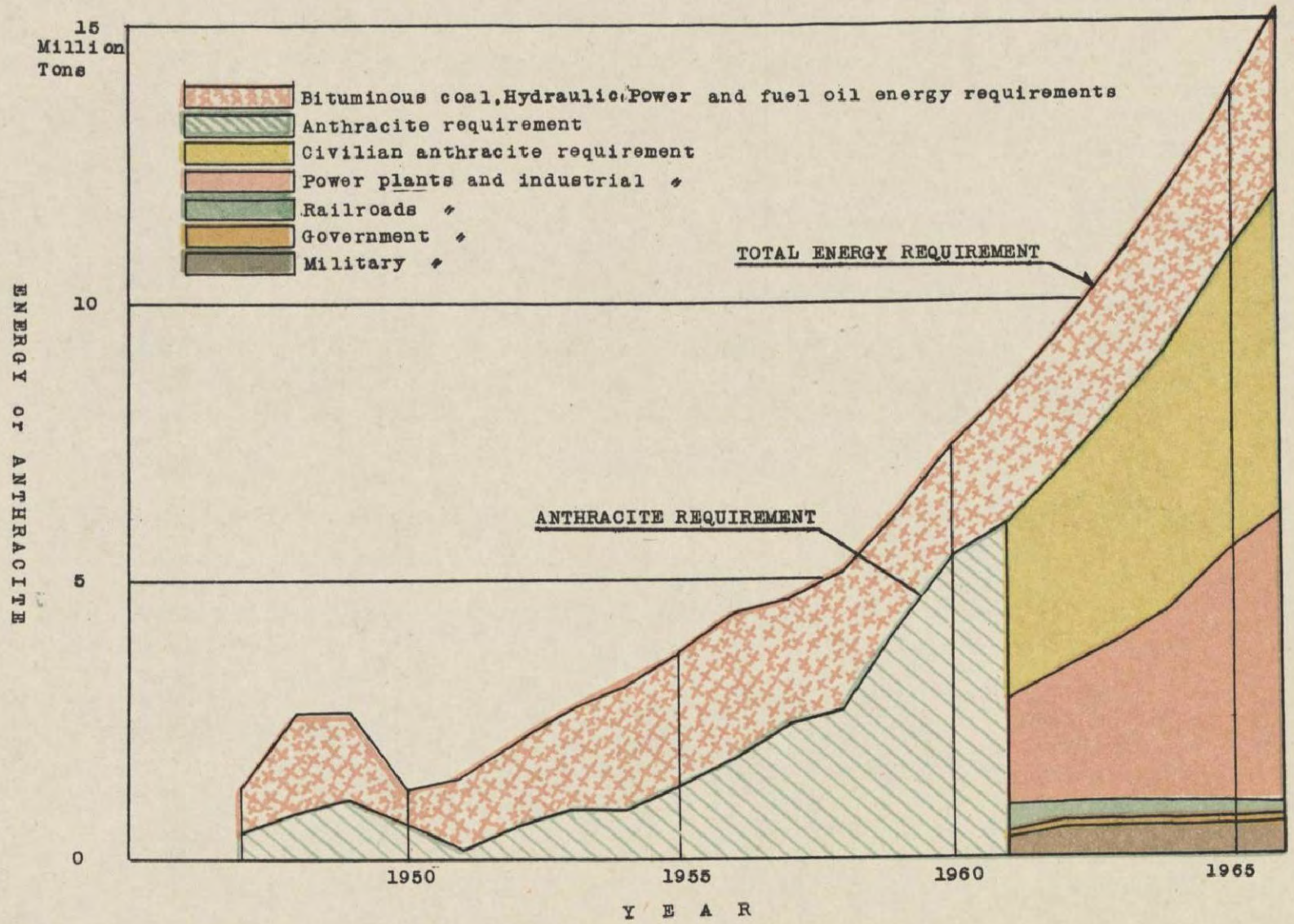
## ANALYSIS OF FUTURE ANTHRACITE DEMAND

Table No. 4

| Year | M | | G | | R | | P | | C | | T | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Minitary | | Government | | Railroads | | Power Plants & Industry | | Civilian | | Total | |
| | T | % | T | % | T | % | T | % | T | % | T | % |
| 1955 | 189,593 | 15.74 | 63,894 | 5.3 | 91,424 | 7.6 | 251,153 | 20.96 | 608,088 | 50.4 | 1,204,072 | 100 |
| 1956 | 183,124 | 9.82 | 62,353 | 3.39 | 191,987 | 10.38 | 553,491 | 29.71 | 863,422 | 46.7 | 1,853,377 | 100 |
| 1957 | 209,548 | 9.43 | 80,722 | 3.64 | 155,013 | 6.98 | 851,321 | 42.35 | 922,646 | 37.6 | 2,219,245 | 100 |
| 1958 | 350,633 | 14.6 | 60,131 | 2.45 | 175,312 | 7.12 | 749,624 | 29.13 | 1,120,314 | 46.7 | 2,456,015 | 100 |
| 1959 | 349,610 | 9.03 | 109,758 | 2.84 | 385,063 | 9.93 | 737,124 | 19.00 | 2,287,789 | 59.2 | 3,869,344 | 100 |
| 1960 | 359,350 | 7.5 | 99,191 | 1.9 | 360,400 | 7.5 | 979,810 | 20.40 | 3,023,937 | 62.7 | 4,822,288 | 100 |
| 1961 | 355,100 | 5.96 | 112,000 | 1.88 | 350,000 | 5.88 | 2,050,900 | 24.40 | 3,085,000 | 51.88 | 5,953,000 | 100 |
| 1962 | 500,000 | 7.26 | 150,000 | 2.18 | 310,000 | 4.50 | 2,370,000 | 34.40 | 3,558,000 | 51.66 | 6,888,000 | 100 |
| 1963 | 500,000 | 6.31 | 160,000 | 2.10 | 280,000 | 3.54 | 2,911,000 | 36.75 | 4,072,000 | 51.3 | 7,923,000 | 100 |
| 1964 | 500,000 | 5.51 | 180,000 | 1.98 | 250,000 | 2.76 | 3,525,000 | 38.80 | 4,628,000 | 50.95 | 9,083,000 | 100 |
| 1965 | 500,000 | 4.72 | 200,000 | 1.89 | 220,000 | 2.08 | 4,483,000 | 42.40 | 5,183,000 | 48.91 | 10,586,000 | 100 |
| 1966 | 500,000 | 4.22 | 200,000 | 1.69 | 200,000 | 1.69 | 5,179,000 | 43.70 | 5,779,000 | 48.70 | 11,858,000 | 100 |

(Fig No.4)

# ANALYSIS OF ANTHRACITE DEMAND



oil in railroads and Electrification of Railroad facilities. Figures calculated by the Government were adapted in (M), (G), and (R) column on Table No. 4.

As to the trend of anthracite demand for civilian use, simple correlation with industrial production index was chosen to get the following ($C_1$) equation by the past 6 years' performances.

$$Yc = 38\ X_1 - 2{,}168 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (C_1)$$

where; Yc = 1,000 tons of civilian use

$X_1$ = I.P.I.

On the other hand, the trend of civilian anthracite demand should also correlate with the population. Hence, ($C_2$) equation shown below was calculated to see future civilian demand by the method of simple correlation.

$$Yc = 817.74\ X_2 - 17{,}800 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (C_2)$$

where; Yc = 1,000 tons of civilian use

$X_2$ = Population in million

The estimated anthracite demands by ($C_1$) and ($C_2$) equations were averaged to presume the actual future anthracite requirements for civilian use. But, this future anthracite demand for civilian use is merely a theoretical estimates of the demand based on trend of past record. The energy supply and demand is consists of anthracite

as well as wood and straw available locally in country sides. And because this wood and straw energy is forming the major portion of civilian heat energy requirement, the anthracite is participating only a portion of total civilian heat energy. Therefore, we will have to know the pervasiveness of anthracite into civilian heat energy consumption. It is far behind to consider the pervasion of anthracite into total civilian heat energy. Hence, if we look at the percentages of anthracite which will occupy in heat energy consumption of people who will live in cities and Ups (Major villege in a county) along the railroad tracks of South Korea, it will be as follows:

CIVILIAN ANTHRACITE CONSUMPTION ANALYSIS

Table No. 5.

| Year | Cities & Ups along Railroad Tracks | | Anthracite Supply | |
|---|---|---|---|---|
| | No.of Households in 1,000 | Energy required in 1,000 ₩ Anthracite Equivalent | 1,000 Tons | % |
| 1960 | 1,581 | 5,428 | 2,910 | 53.6 |
| 1961 | 1,621 | 5,585 | 3,085 | 55.2 |
| 1962 | 1,673 | 5,746 | 3,558 | 61.9 |
| 1963 | 1,722 | 5,911 | 4,072 | 68.9 |
| 1964 | 1,771 | 6,081 | 4,628 | 76.1 |
| 1965 | 1,822 | 6,256 | 5,183 | 82.8 |
| 1966 | 1,875 | 6,436 | 5,779 | 89.8 |

The number of households and energy requirement in the cities and ups along the railroad tracks within above table were estimated by the rate of population growth (2.88 %) based on actual counting in the end of 1960. As it can be seen in the above table, although the anthracite percentage is increasing year by year, the total civilian anthracite supply could not meet the whole energy demand of cities and Ups along the railroad track and even by 1966 roughly 10 % of those energy requirements will have to supplied in other kind of energy i.e., Wood and Straw.

The power generating and industrial use can, now, be easily calculated by subtracting Military use, Government use, Railroads use, and Civilian use from the total anthracite demand. The final analysis of anthracite demand by it's categories of consumption can be seen in Table No. 4 and Fig No. 4. If we look at the distribution of consumption, civilian use (48.70%) and Power generating and industrial use (43.70%) will occupy the most portion of total demand in 1966.

## 11. Conclusion

Thus, we have the future energy demand by it's sources and the anthracite requirements by customers. All of foregoing presumptions are results of our brief study on Korean energy problem. However, whether the future energy and anthracite demand will follow the

tracks of our estimates or will make another trend is entirely depend upon; first, the condition of our economic growth or the Government's economic policies; second, the reliability of our statistical data used in this study. As to the reliability in the method of our forecastings, it is still a problem to be studied. However, the purpose of this study was to look upon the broad trends of our energy and anthracite demands in future, and therefore we think we have been served considerably for such purpose. Furthermore, the energy economy will have to be improved by creating more power plants and industrialization facilities and concentrating these projects in coal field area so that the low grade coal produced could be consumed without causing much trouble in transportation and turned into other form of energy easy to transport.

## CHAPTER III DESCRIPTION OF PROJECTS

1. Coal Mines Development
   - A) Test Drilling for coal fields
   - B) Coal mines development
2. Transmission Lines Layout and Railroads Construction
3. Coal Wagons and Electrification of Railroads
4. Ocean Transportation
   - A) Enlargement of Mukho and Pusan ports facilities
   - B) Procurement of ships for coal transportation
5. Machineries and Electric Equipments Manufacturing Factories for Coal Mines

## CHAPTER III DESCRIPTION OF PROJECTS

### 1. Coal Mines Development

#### A) Test drilling for coal fields

The major anthracite fields in South Korea are Samchuck, Yongwol, Munkyung, Hwasun, Jungsun, Kangnung, Okdong, Danyang and Chungnam coal fields. Amongst the Samchuck coal field is the only one that has been developed effectively and geological survey is progressed. In the other coal fields, geological survey is not yet completed and accordingly the development is being processed only to a portion. The anthracite reserves of above coal fields estimated by various data available up to date are shown on Table No. 6. The total area of coal fields is roughly 700 million square meters and the total reserves is approximately 1.6 billion tons.

The anthracite seams of South Korea are mostly presented in irregular state of pockets with steep inclination and in state of broken formation due to the extreme geological movements and reactions such as faults, foldings and etc. The outcrops are usually found in higher spots than the local drainage level. Therefore, test drilling must be done with dense in order to confirm exact amount of reserves and geological structure of this area. This will make this test

## ANTHRACITE RESERVES OF SOUTH KOREA

Table No. 6

As of May 8, 1961

| Coal Fields | DHCC or Private | Area ($M^2$) | Reserves (₩) |
|---|---|---|---|
| Samchuck | DHCC | 62,000,000 | 247,000,000 |
| | Private | 86,000,000 | 310,000,000 |
| | Total | 148,000,000 | 557,000,000 |
| Yongwol | DHCC | 3,200,000 | 16,570,000 |
| | Private | 400,000 | 930,000 |
| | Total | 3,600,000 | 17,500,000 |
| Munkyung | DHCC | 860,000 | 1,000,000 |
| | DHCC | 600,000 | 4,840,000 |
| | Sub-Total | 1,460,000 | 5,840,000 |
| | Private | 11,100,000 | 5,000,000 |
| | Private | 13,000,000 | 8,160,000 |
| | Sub-Total | 24,100,000 | 23,160,000 |
| | Total | 25,560,000 | 29,000,000 |
| Hwasun | DHCC | 5,158,000 | 19,110,000 |
| | Private | 20,800,000 | 38,890,000 |
| | Total | 25,968,000 | 53,000,000 |
| Jungsun | Private | 330,000,000 | 683,000,000 |
| Kangnung | Private | 42,000,000 | 86,900,000 |
| Okdong | Private | 3,700,000 | 11,400,000 |
| Danyang | Private | 33,500,000 | 54,000,000 |
| Chungnam | Private | 110,000,000 | 12,000,000 |
| GRAND TOTAL | | 722,328,000 | 1,503,800,000 |

drilling work rather hard. Test drilling machines available within domestic will be about 14 sets and capable drilling depth be 1,300 meters to 600 meters.

The main purpose of test drilling work is to prove the geological structure in complex Korean coal fields with foldings. In order to prove the reserves the under-ground prospecting tunnel excavation as well as test drilling is required. This underground prospecting tunnel is usually serve as mining level afterwards.

The required drilling depth for coal mines development during five years of planning period is estimated to be 400 meters average and the cost per meter will not be less than $20.00 The cost for test drillings and geological survey for the development of a ton of annual production will be 325 hwan or 25 ¢ as dollar cost and 375 hwan as hwan cost. The total amount required for the period of this plan will estimated to be $ 2,125,000 of dollar cost and Hw 3,187 million of Hwan cost. This exploration work is already started by the GSIK (Geological Servey in Korea) and Dai Han Coal Corporation with the assistance of ICA. However, in future, to accelerate this work, an organization and improvement is necessary for the general mobilization of geologists and engineers.

B) Coal mines development

The estimated production plan by Dai Han Coal Corporation and private mines and by each coal field to meet the anthracite demand anticipated during the period of five-year development plan is shown on Table No. 7. The expected production of 1961 is 2.9 million tons from Dai Han Coal Corporation mines and 2.7 million tons from private mines or 5.6 million tons altogether. During the five-year development period, the Dai Han Coal Corporation will have to bring up its' annual production capacity to 4.2 million tons and the private mines to 7,540,000 tons. The production ratio of Dai Han Coal Corporation and private mines in 1966, the final year of the five-year development period, should have been set by the ratio of coal seam area under their mining rights, but the Dai Han Coal Corporation's production assignment was increased considering the thickness of coal seams and the avilable geological survey data.

The Dai Han Coal Corporation assignement by each mines is also shown on Table No. 7. Ofcourse, the portional production schedule will be fluctuated by the condition of coal seams and by the condition of management, however, the overall production scale will be met. The production of private mines could not expect much improvement from the current production line of 2.7 million tons per year during the next few year without possitive assistance of the

# COAL PRODUCTION PLAN

Table No. 7 Unit=Ton

| Class. | | Coal Mines | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 |
|---|---|---|---|---|---|---|---|---|---|---|
| Existing Coal Fields | DHCC Mines | Changsung | 1,280,000 | 1,200,000 | 1,200,000 | 1,440,000 | 1,440,000 | 1,400,000 | 1,440,000 | 1,440,000 |
| | | Hambaek | 202,000 | 360,000 | 480,000 | 600,000 | 720,000 | 840,000 | 840,000 | 840,000 |
| | | Dogye | 538,000 | 600,000 | 720,000 | 720,000 | 720,000 | 720,000 | 720,000 | 720,000 |
| | | Yongwol | 225,000 | 300,000 | 360,000 | 360,000 | 360,000 | 360,000 | 360,000 | 360,000 |
| | | Eunsung | 233,000 | 240,000 | 240,000 | 240,000 | 240,000 | 240,000 | 240,000 | 240,000 |
| | | Hwasun | 272,000 | 480,000 | 600,000 | 600,000 | 600,000 | 600,000 | 600,000 | 600,000 |
| | | Sub-Total | 2,800,000 | 3,180,000 | 3,600,000 | 3,960,000 | 4,080,000 | 4,200,000 | 4,200,000 | 4,200,000 |
| | Private Mines | 1. Hambaek(W) | 250,000 | 250,000 | 250,000 | 250,000 | 250,000 | 250,000 | | |
| | | 2. Hambaek(E) | 210,000 | 210,000 | 210,000 | 210,000 | 210,000 | 210,000 | | |
| | | 3. Hwangzi | 770,000 | 770,000 | 770,000 | 770,000 | 770,000 | 770,000 | | |
| | | 4. Hamtae | 230,000 | 230,000 | 230,000 | 230,000 | 230,000 | 230,000 | | |
| | | 5. KangWon | 360,000 | 360,000 | 360,000 | 360,000 | 360,000 | 360,000 | | |
| | | 6. Okdong | 300,000 | 300,000 | 300,000 | 300,000 | 300,000 | 300,000 | | |
| | | 7. Kangnung | 140,000 | 140,000 | 140,000 | 140,000 | 140,000 | 140,000 | | |
| | | 8. Munkyung | 180,000 | 180,000 | 180,000 | 180,000 | 180,000 | 180,000 | | |
| | | 9. Hwasun | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 | | |
| | | 10. Others | 220,000 | 220,000 | 220,000 | 220,000 | 220,000 | 220,000 | | |
| | | Sub-Total | 2,700,000 | 2,700,000 | 2,700,000 | 2,700,000 | 2,700,000 | 2,700,000 | | |
| | TOTAL | | 5,500,000 | 5,880,000 | 6,300,000 | 6,660,000 | 6,780,000 | 6,900,000 | | |
| New Coal Fields | 1. Hambaek (West) | | | | | | 30,000 | 590,000 | 1,920,000 | 2,000,000 |
| | 2. Hambaek (East) | | | | | | | 750,000 | 1,960,000 | 2,000,000 |
| | 3. Hwangzi | | | | | | 190,000 | 190,000 | 960,000 | 1,000,000 |
| | 4. Hamtae | | | | 100,000 | 170,000 | 170,000 | 170,000 | 400,000 | 400,000 |
| | 5. KangWon | | | | | 40,000 | 40,000 | 40,000 | 400,000 | 400,000 |
| | 6. Okdong | | | | | 100,000 | 100,000 | 100,000 | 400,000 | 400,000 |
| | 7. Jungsun | | | | | | 960,000 | 960,000 | 960,000 | 2,000,000 |
| | 8. Kangnung | | | | | | 820,000 | 820,000 | 960,000 | 960,000 |
| | 9. Munkyung | | | | | | 780,000 | 780,000 | 960,000 | 960,000 |
| | 10. Hwasun | | | | | | 440,000 | 440,000 | 480,000 | 480,000 |
| | TOTAL | | | | 100,000 | 310,000 | 3,530,000 | 4,840,000 | 9,400,000 | 10,600,000 |
| GRAND TOTAL | | | 5,500,000 | 5,880,000 | 6,400,000 | 6,970,000 | 10,310,000 | 11,740,000 | 13,600,000 | 14,800,000 |
| Coal Demand | | | 5,953,000 | 6,888,000 | 7,923,000 | 9,083,000 | 10,586,000 | 11,858,000 | | |
| Supply Shortages | | | 453,000 | 1,008,000 | 1,523,000 | 2,113,000 | 276,000 | 118,000 | | |

Government and development by a large unit. Even that will face a problem of shuting down the mines due to the unprofitable business within the current limit of coal selling price in next 2 to 3 years in case the national price index goes up. The most of private mines except few are producing by a large number of very small operators who have opened short drifts in the more easily accessible coal outcrops without electricity nor railroad transportation facilities. Accordingly, the business will drop after certain length of period and establishment of the development plan at such time will be too late and the shortages in coal supply can not be avoided.

Therefore, the Government must legislate the Coal Mines Development Acceleration Law (Tentative Name) and must carry out resolutely the necessary steps in the direction to rear large scale private business corporations.

With the currently available data, the development base where railroads and transmission line should be installed could be chosen by coal fields as follows:

Samchuck Coal Field:

1. Hwangzi-Ri, Changsung-Up, Samchuck-Gun, Kangwon-Do.
2. Murung-Ri, Nam-Myun, Jungsun-Gun, Kangwon-Do.

3. Changsung-Up, Samchuck-Gun, Kangwon-Do.

Jungsung Coal Field:

1. Najun-Ri, Buk-Myun, Jungsun-Gun, Kangwon-Do.

Munkyung Coal Field:

1. Buljung-Ri, Masung-Myun, Munkyung-Gun, Kyungbuk,

Hwasun Coal Field:

1. Obong-Ri, Chunyang-Myun, Hwasun-Gun, Junnam.

Kangnung Coal Field:

1. Sansungoo-Ri, Kangdong-Myun, Myungju-Gun, Kangwon-Do.

The development base implies the terminal of railroad line in coal field. In this development base, surface mining facilities including preparation plant should be concentrated. The above listed development base will subject to some changes accorded by the results of geological survey and mine development plan. Since the Government is investing a considerable amount of money for the railroads and transmission lines, a certain geographical limitation could not be avoided in order to prevent the waste of national investment and to utilize most effectively the investment.

The required investment per ton of annual production for the private mines promised on large unit development is estimated to be Hw 3,900 ($ 3.00) of dollar cost and Hw 5,200 ($ 4.00 excluding custom duties and other taxes for the importation of foreign materials by the dollar cost anticipated) of hwan cost by the past experience of Dai Han Coal Corporation investment. The Government will have to gurantee to loan approximately one half of the hwan cost requirements for these private mines. The forementioned investment implies the total investment for the development of areas above not too far below the local drainage level. The development of deeper area will subject to an additional investment.

Furthermore, the amount of investment was evaluated upon the principle that all the machineries and equipments required for the coal mines will be manufactured within Korea as far as possible by importing the raw materials even though the quality is low. In case of Dai Han Coal Corporation investments, all of hwan cost requirement except dollar cost will be squeezed out or the reinvestment source. Also the designing and procedure of mine facilities will have to suit the principle and all of past plan will be re-checked. The investment of Dai Han Coal Corporation is emphasized on the maintaining of current production line caused by the movement of operation into deeper areas. For example, Chan sung shaft sinking, preparation plants installation, extension of Dunsung slope and

re-arrangement of surface facilities could be named.

2. Transmission Lines Layout and Railroads Construction

As it has been previously pointed out, the transmission lines layout and railroads construction to each development base of component coal fields is the essential factor. The transmission lines layout could be done easily done by extending from existing lines and it should be proceeded upon the long term transmission line net construction plant of whole South Korea and be voiding any waste of construction investment.

The railroads construction required for the coal mines development is already started by the Ministry of Transportation, ROK. The Hwangzi A Line (Tongri - Simpori) and Hwangzi B Line (Baeksanri - Hwangzi) which currently engaging for the construction will be completed by 1964. The North Donghae Line from Mukho to Okge is completed this yesr. Additional constructions needed to each development base are as follows:

Yaomi - Murung

Hwangzi - Chomak

Mungok - Sodo

Byulugok - Jungsun

Okdong - Kangnung

The cost per meter of railroad construction is estimated as $ 20,000 (dollar cost) and Hw 289 million (hwan cost). All of this cost is considered to be supported by the Ministry of Transportation.

The coal transportation of major private mines is being done by trucks passing average distances of 15 to 40 KM in mountaineous area to the nearest railroad station. Therefore the above railroad construction will not only serve for the acceleration of large unit coal mine development, but also even before full scale production from the large unit mines start, it could serve for the acceleration of existing petty mines production could give better chance to invest the retained small capital for the large unit development.

3. Coal Wagons and Electrification of Railroads

The existing coal wagons designed for the transportation of coal are only 280 sets but it is not manufactured in uniform specification. Therefore other wagons for the general loading purpose have been used for the coal transportation. Besides the loading and unloading facilities at the loading point of coal fields and at the destination of delivery are not sufficient and cause the low turnover of coal wagons.

At present, mines under Dai Han Coal Corporation and few other private mines are equiped with coal bunker and handled both by machines and by manpower. In all other mines, coal has to be loaded solely by menpower on the flat ground. The turn-over rate between Seoul and Samchuck-Gun, Kangwon-Do of all wagons used for the transportation of coal is about 5.7 days for full one round trip. Therefore, during the period of five-year coal mines development plan, coal wagons to transport annual increased production will have to manufactured and supplied 600 sets per year. It could be manufactured in Korea by importing necessary raw materials or may be procured from a foreign country in case domestic manufacturing is impossible. The total number of coal wagon required to be increased during the period of five years is estimated as roughly 3,000 sets. The price of a wagon in case of importing from foreign country will approximately be $10,000. Besides 20 sets of diesel locomotives cost $ 500,000 per set will also be required.

If the electrification of railroad facilities to be constructed or already constructed in coal fields could be achieved, not only the electric power generated by the low grade coal which will have to be consumed at the mines otherwise can be utilized, but also it will relieve the limitation of inclination on the new railroad lines and save the construction cost as well as the consumption of fuel oil which has to be imported. As the primary object of electrification lines, between Jechun and Youngju, Jechun and Jungsun, Chulam

and Youngju, Chulam and Mukho, Hwangzi Line and other side lines in each railroad stations could be named. The total distance of lines listed above is approximately 420 KM. Furthermore, 90 KM of transmission lines, 11 sub-stations, communication and signal facilities, garages and other supporting facilities must also be constructed. The dollar cost required for the electrification of railroads is 11 million dollars and the hwan cost is 10 billion hwan. In the above amount, cost for 30 sets of electric locomotives is included.

4. Ocean Transportation

A) Enlargement of Mukho and Pusan ports facilities

Among the many harbors in Korea, Pusan and Mukho are the busiest ones for coal loadings and unloadings and their decking capacities are in position to be increased according to the coal production increasement plan.

Port of Mukho:

The port of Mukho is mainly served for the loadings of anthracite produced in Samchuck Coal Field to ships waiting. For the unloadings of coal from coal wagons, a concrete pier is installed for 200 meters long. Below this pier, a 36" width belt conveyor is

installed for 150 meters. Two more sets of belt conveyors are existing to load coal to the ships; one of them is connected to the belt conveyor mentioned above and the other is connected to the coal unloading facilities from trucks.

As of date the loading capacity of this port is less than 1 million tons per year. Therefore the capacity must be increased to 3 millions of loading tons per annum. This project is to dredge the harbor, equip additional conveyor facilities to load more loads to the ships, to have additional conveyors in coal yard, and to install more loading and unloading machines. The cost estimated for this will be $ 200,000 of dollar cost and Hw 884 million of hwan cost.

Port of Pusan:

In the Pusan harbor, a coal yard managed by Dai Han Coal Corporation is provided but the quay wall of the coal yard is not dredged. Therefore, at the present time, the ships must be stayed 600 meters away from the quay wall and coal has to be hauled by small barges to the wall and land solely by men-power. Recent record of coal loading per year is only 600,000 tons and accordingly associated with great loading expenses and unefficiency.

This project is planned under such uneconomical condition to increase the landing capacity to a million tons per year by performing dredge work in the coast, by constructing permanent quay wall, eliminating delays of barge haulage, and by installing the overhead travelling crane in the coal yard; thus an efficient landing could be achieved.

Due to the urgency, this project must be done in a short time and cost required for this project is 1.6 million dollar of dollar cost and Hw 1,976 million of hwan cost.

B) Procurement of ships for coal transportation

Dai Han Coal Corporation owns 3 ships of 2,800 tons class, at the present time, which are transporting 400,000 tons of Dai Han Coal Corporation anthracite production per annum from the port of Mukho to Pusan or Masan Ports.

The coal demand of southern Korean provinces centering at Pusan is increasing year by year. Also, Korea must export more than one half million tons of coal every year to Japan in future. Therefore 5 additional ships of 4,000 ton to 5,000 ton class should be available for the increased capacity of ocean freight. The cost of ship is estimated as $ 1.2 million per set.

## 5. Machineries and Electric Equipments Manufacturing Factories for Coal Mines

Increased coal development plan in South Korea will be continued after 1966. All the machinery that needed after 1966 except special machines must be built at home. Also parts for imported mine machine must be built and supplied except special parts by home maker.

At present, some of the mine machines are produced at home even it is not complete as foreign countires. Still some machines can not produced in this country.

Therefore, supplement of the domestic machine makers, educate the engineers, train-up of excellent manufacturing plant by purchasing patent and build of new manufacturing plant are necessary. Besides, to imporve the manufacturing plant, Dai Han Coal Corporation will have to submit the unified specification of machineries and equipments for coal mines. The manufacturing plant of fine quality producer will have to grant a special business transaction with coal industry for mutual profitability and have to be under the aims of guranttee policy to bring up the business. The list of machineries that can be made in Korea is as follows:

# LIST OF EQUIPMENTS MANUFACTURED IN KOREA

Table No. 8

| No. | Name of Machines | Factory | Quality | What should be done |
|---|---|---|---|---|
| 1 | Rock drill | No | – | Installation – the whole process.<br>Manufacturing – by import raw materials. |
| 2 | Hoist, pump, fan, loader, locomotive, compressor, coal car & etc. | Yes | Low | Installation – gear & crew cutting machine, heat treating equipment, gear grinder, welder, forging machine, balance meter & etc.<br>Manufacturing – by import raw materials. |
| 3 | Transformer, motor, switches, meter, & etc. | Yes but few | Low | Installation – annealing equipment of Si – Fe plates, painting & baking equipment and other miscellaneous equipments.<br>Manufacturing – by import most of raw materials. |
| 4 | Ball & roller bearing | Yes | Reasonable | Installation – equipments to manufacture roller bearing.<br>Manufacturing – by import all of raw materials. |
| 5 | Rubber belt | Yes | Good | Import – raw materials |
| 6 | Wire rope | Yes ? | ? | Import – raw materials |
| 7 | Rail | No. | – | Purchase – rolling machine, Import – part of raw materials |
| 8 | Pipe | Yes | Good | Purchase – above 2" pipes, Import – all of raw materials |
| 9 | Wire screen cloth | No | | Purchase – the whole facilities, Import – raw materials |
| 10 | Cap lamp and bulb | Yes ? | | Purchase – the whole facilities, Import – raw materials |
| 11 | Trolley wire, electric wire and cable | Yes | Low | Purchase – partial facilities, Import – partial raw materials |
| 12 | Insulator | Yes | Low | Purchase – all facilities |
| 13 | Rectifier | No | | Purchase – all facilities, Import – raw materials |
| 14 | Steel bit | No | | Purchase – all facilities, Import – raw materials |
| 15 | Electric detonator | Yes | Low | Purchase – partial facilities, Import – raw materials |
| 16 | Battery | Yes | Low | Purchase – partial facilities, Import – raw materials |
| 17 | Packings | Yes but few | Low | Purchase – partial facilities, Import – raw materials |
| 18 | Steel arch | Yes | – | Purchase – rolling equipments, Import – raw materials |
| 19 | Copper plate | Yes | Good | |
| 20 | Carbide | Yes | Good | |

## CHAPTER IV RECAPITULATION - EXPENDITURES BY YEARS

## CHAPTER IV RECAPITULATION - EXPENDITURES BY YEARS

These total cost estimates analysed in details including the sources of fund each expenditures to be financed are shown on Table No. 9. The estimated dollar costs as well as local fund requirements of the projects together with the expenditures by years are shown on Table No. 10. The dollar cost required for the main project or the coal mines development will estimated to be $ 3.00 per ton of capable production by developments. The Hwan cost requirements for the same will be $ 4.00 or Hw 5,200 per ton of capable production by developments. All of the dollar cost requirement for this grand project should be financed in a form of long-term credit from a foreign country. The local fund needed for the development of Dai Han Coal Corporation mines will be alloted by their own source of fund. However, one half of the local fund requirement for private mines will have to be convered on a loan basis and the rest of amount must come from their own source of fund. For the supporting projects, the whole local fund required will be financed by the Korean Government. Fig. No. 5 is graphic presentation of annual dollar and hwan cost requirements. The terms of credit; interest rates and repayment schedule of each projects will be mentioned in the later Chapter.

Table No. 9

## DOLLAR AND HWAN COST ESTIMATES-BY PROJECTS AND BY SOURCE OF FINANCE

| PROJECTS | | | | TOTAL ESTIMATED COSTS | | | SOURCE OF FINANCE | | | EXPLANATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dollar Cost in $ | Hwan Cost in 1,000 HW | Total in 1,000 HW | Own Source of Fund in 1,000 HW | Foreign Credit in $ | Government Loan in 1,000 HW | |
| Main Project | Coal Mines Development | Dai Han Coal Corporation Mines | | 9,259,000 | 12,799,000 | 24,835,700 | 12,799,000 | 9,259,000 | - | 1. Costs for DHCC mines were estimated upon the actual cost needed for each mines. |
| | | Private Mines | Hambaek (West) | 6,000,000 | 10,400,000 | 18,200,000 | 5,200,000 | 6,000,000 | 5,200,000 | 2. Costs for private mines were estimated as follows: Dollar cost = $ 3.00 x Production in tons. Hwan cost = $ 4.00 x Hw 1,300 x Production in tons. |
| | | | Hambaek (East) | 6,000,000 | 10,400,000 | 18,200,000 | 5,200,000 | 6,000,000 | 6,200,000 | |
| | | | Hwangzi | 3,000,000 | 5,200,000 | 9,100,000 | 2,600,000 | 3,000,000 | 2,600,000 | |
| | | | Hamtae | 510,000 | 884,000 | 1,547,000 | 442,000 | 510,000 | 442,000 | |
| | | | Kangwon | 120,000 | 208,000 | 364,000 | 104,000 | 120,000 | 104,000 | |
| | | | Okdong | 300,000 | 520,000 | 910,000 | 260,000 | 300,000 | 260,000 | |
| | | | Jungsun | 6,000,000 | 10,400,000 | 18,200,000 | 52,000,000 | 6,000,000 | 5,200,000 | |
| | | | Kangnung | 2,460,000 | 4,264,000 | 7,462,000 | 2,132,000 | 2,460,000 | 2,132,000 | |
| | | | Munkyung | 2,440,000 | 4,056,000 | 7,228,000 | 2,028,000 | 2,440,000 | 2,028,000 | |
| | | | Hwasun | 1,320,000 | 2,288,000 | 4,004,000 | 1,144,000 | 1,320,000 | 1,144,500 | |
| | | | Test Drillings | 2,125,000 | 3,187,000 | 5,949,500 | 1,593,500 | 2,125,000 | 1,593,500 | |
| | | | Sub - Total | 30,275,000 | 51,007,000 | 91,164,500 | 25,903,500 | 30,275,000 | 25,903,500 | |
| | | Total | | 39,534,000 | 63,806,000 | 116,000,200 | 38,702,500 | 39,534,000 | 25,903,500 | |
| Supporting Project | Transmission Lines Layout | | Hwangzi | 134,800 | 63,800 | 239,040 | - | 134,800 | 63,000 | Total Capacity of Transfomer = 5,000 KVA, Line = 2 KM. |
| | | | Hambaek | 135,000 | 85,800 | 261,300 | - | 135,000 | 85,800 | |
| | | | Kangnung | 200,600 | 184,900 | 446,680 | - | 200,000 | 184,900 | |
| | | | Jungsun | 340,200 | 262,000 | 704,260 | - | 340,200 | 262,000 | |
| | | | Munkyung | 233,400 | 270,500 | 573,500 | - | 233,400 | 270,500 | |
| | | | Hwasun | 114,000 | 131,700 | 299,900 | - | 114,000 | 131,700 | |
| | | | Sub - Total | 1,158,000 | 998,700 | 2,504,300 | - | 1,158,000 | 998,700 | |
| | Inland Transportation | Railroads Construction | Yaemi -Murung | 420,000 | 6,069,000 | 6,615,000 | - | 420,000 | 6,069,000 | Distance 21 KM |
| | | | Hwangzi -Hyulam | 140,000 | 2,023,000 | 2,205,000 | - | 140,000 | 2,023,000 | Distance 7 KM |
| | | | Mungok -Sodo | 80,000 | 543,200 | 647,200 | - | 80,000 | 543,200 | Distance 4 KM |
| | | | Byulugok-Jungsun | 320,000 | 4,624,000 | 5,040,000 | - | 320,000 | 4,624,000 | Distance 16 KM |
| | | | Okdong -Kangnung | 552,000 | 1,385,400 | 2,103,000 | - | 552,000 | 1,385,400 | Distance 21.6 KM |
| | | | Sub-Total | 1,512,000 | 14,644,600 | 16,610,000 | - | 1,512,000 | 14,644,600 | |
| | | Electrification of Railroads | | 11,000,000 | 10,360,000 | 24,660,000 | - | 11,000,000 | 10,360,000 | Electric Locomotives 30 sets Diesel Locomotives 20 sets & Coal Wagons 3,000 sets |
| | | Coal Wagons | | 40,000,000 | | 52,000,000 | - | 40,000,000 | | |
| | | Sub - Total | | 51,000,000 | 10,360,000 | 76,660,000 | - | 51,000,000 | 10,360,000 | |
| | Ocean Transportation | Porst Facilities | Port of Mukho | 200,000 | 884,000 | 1,144,000 | - | 200,000 | 884,000 | Repair and enlargement of ports facilities. |
| | | | Port of Busan | 1,600,000 | 1,976,000 | 4,056,000 | - | 1,600,000 | 1,976,000 | |
| | | | Sub - Total | 1,800,000 | 2,860,000 | 5,200,000 | - | 1,800,000 | 2,860,000 | |
| | | Procurement of Coal Ships | | 6,000,000 | - | 7,800,000 | - | 6,800,000 | - | 5 coal ships of 4,000 to 6,000 ton class |
| | | Sub - Total | | 7,800,000 | 2,860,000 | 13,000,000 | - | 7,800,000 | 2,860,000 | |
| | | Total | | 61,470,000 | 28,863,300 | 108,774,000 | - | 61,470,000 | 28,863,300 | |
| GRAND TOTAL | | | | 101,004,000 | 93,469,300 | 224,774,500 | 38,702,500 | 101,004,000 | 54,766,800 | |

RECAPITULATION

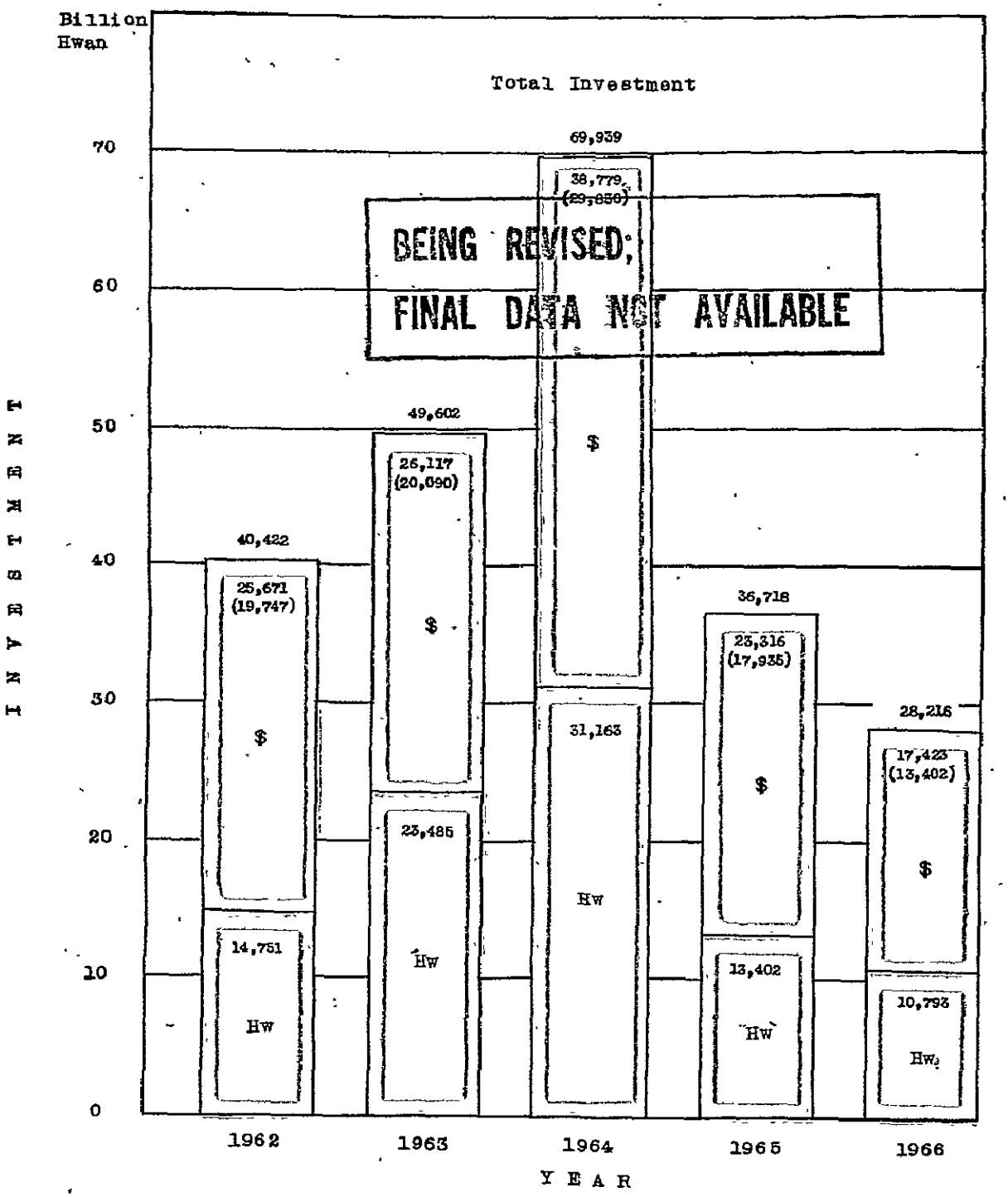
TABLE No.10 DOLLAR AND HWAN COST ESTIMATES BY YEAR AND BY PROJECTS Unit $ = 1,000 HW = 1,000,000

| | PROJECTS | TOTAL | | | | 1962 | | | | 1963 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dollar Cost | Hwan Cost | | | Dollar Cost | Hwan Cost | | | Dollar Cost | Hwan Cost | | |
| | | | Meterial | Labor | Total | | Meterial | Labor | Total | | Meterial | Labor | Total |
| MAIN PROJECT | Coal Mines Development: | $ | | | | $ | | | | $ | | | |
| | IHCC Mines | 9,259 | 4,795 | 8,004 | 12,799 | 1,817 | 1,189 | 1,988 | 3,177 | 3,034 | 907 | 1,511 | 2,418 |
| | Private Mines | 28,150 | 18,254 | 30,366 | 48,620 | 3,000 | 1,950 | 3,250 | 5,200 | 3,930 | 2,554 | 4,258 | 6,812 |
| | Total Mines | 37,409 | 23,049 | 38,370 | 61,419 | 4,817 | 3,139 | 5,238 | 8,377 | 6,964 | 3,461 | 5,769 | 9,230 |
| | Test Drilling | 2,125 | 1,192 | 1,995 | 3,187 | 531 | 298 | 499 | 797 | 531 | 298 | 499 | 797 |
| | Total | 39,534 | 24,241 | 40,365 | 64,606 | 5,348 | 3,437 | 5,174 | 9,174 | 7,495 | 3,769 | 6,268 | 10,027 |
| SUPPORTING PROJECT | Transmission Line | 1,158 | 374.8 | 623.9 | 998.7 | 134.8 | 23.9 | 39.9 | 63.8 | 1,023.2 | 350.9 | 584 | 934.9 |
| | Inland Transportation | 52,512 | 11,958.2 | 13,046.4 | 25,004.6 | 10,484 | 1,816.8 | 3,089 | 4,905.8 | 11,172 | 5,492 | 5,446.4 | 11,848.4 |
| | Ocean Transportation | 7,800 | 1,065 | 1,795 | 2,860 | 3,800 | 845 | 1,430 | 2,275 | 400 | 220 | 365 | 585 |
| | Total | 61,470 | 13,398 | 15,465.3 | 28,863.3 | 14,398.8 | 2,685.1 | 3,491.9 | 5,577 | 12,595.2 | 6,062.9 | 7,395.4 | 13,458.3 |
| GRAND TOTAL | | 101,004 | 37,639 | 55,830.3 | 93,469.3 | 19,746.8 | 5,522.1 | 9,228.9 | 14,751 | 20,090.2 | 9,821.9 | 13,663.4 | 23,485.3 |

| | PROJECTS | 1964 | | | | 1966 | | | | 1966 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dollar Cost | Hwan Cost | | | Dollar Cost | Hwan Cost | | | Dollar Cost | Hwan Cost | | |
| | | | Meterial | Labor | Total | | Meterial | Labor | Total | | Meterial | Labor | Total |
| MAIN PROJECT | Coal Mines Development: | $ | | | | $ | | | | $ | | | |
| | IHCC Mines | 3,203 | 817 | 1,373 | 2,190 | 803 | 1,060 | 1,761 | 2,821 | 402 | 822 | 1,371 | 2,193 |
| | Private Mines | 11,220 | 7,255 | 12,053 | 19,308 | 5,000 | 3,270 | 5,430 | 8,700 | 5,000 | 3,225 | 5,375 | 8,600 |
| | Total Mines | 14,423 | 8,072 | 13,426 | 21,498 | 5,803 | 4,330 | 7,191 | 11,521 | 5,402 | 4,047 | 6,746 | 10,793 |
| | Test Drilling | 531 | 298 | 499 | 797 | 532 | 298 | 498 | 796 | - | - | - | - |
| | Total | 14,954 | 8,370 | 13,925 | 22,295 | 6,335 | 4,628 | 7,689 | 12,317 | 5,402 | 4,047 | 6,746 | 10,793 |
| SUPPORTING PROJECT | Transmission Line | - | - | - | - | - | - | - | - | - | - | - | - |
| | Inland Transportation | 11,276 | 4,590 | 4,278 | 8,868 | 11,600 | 660 | 300 | 960 | 8,000 | - | - | - |
| | Ocean Transportation | 3,600 | - | - | - | - | - | - | - | - | - | - | - |
| | Total | 14,876 | 4,590 | 4,278 | 8,868 | 11,600 | 660 | 300 | 960 | 8,000 | - | - | - |
| GRAND TOTAL | | 29,830 | 12,960 | 18,203 | 31,163 | 17,935 | 5,288 | 7,989 | 13,277 | 13,402 | 4,047 | 6,746 | 10,793 |

# ANUAL INVESTMANT SCHEDULE

( Fig No.5)



# CHAPTER V REDEMPTION SCHEDULES

## CHAPTER V REDEMPTION SCHEDULES

The Table No. 11 shows the redemption schedule of Dai Han Coal Corporation dollar cost requirement in case of financing as a long term credit from a foreign country. The credit will awarded on ten year term from the signing of the contract, but the payments will not be effected until the first shipment of the equipments ordered or two years after the singing of the contract. The annual installments will be $\frac{1}{8}$ or 12.5 % of the principal. Furthermore, annual interest of 6 % is payable for the outstanding balance. For the warrant of the contract, the Bank of Korea will establish an irrevocable L/C in accordance with the contract terms guranteeing the fulfillment of the payment terms.

The Table No. 12 shows the redemption schedule of the existing liabilities of Dai Han Coal Corporation including interest of 8 % per year. The overall repayment schedule of Dai Han Coal Corporation is shown on Table No. 13.

The dollar cost repayment for the private mines are shown on Table No. 14 which was arrived under the same assumption as Dai Han Coal Corporation's credit conditions. The Table No. 15 shows the redemption schedule for the half of the hwan cost requirements which

should be loaned from the Government. The term of the loan is assumed to be same as the dollar cost except the interest rate. The annual interest rate is assumed to be 8 %. The overall redemption schedule of private mines is shown on Table No. 16.

The Table No. 17 shows the dollar cost redemption schedule of Dai Han Coal Corporation and all other private mines. It also shows repayments expressed in hwan equivalent and in anthracite equivalent. The anthracite equivalent shows us the tonnages of coal to be export for the purpose of securing foreign exchange required for the repayments. The repayment schedule for the Dai Han Coal Corporation's existing liabilities and hwan cost requirement of private mines is shown on Table No. 18.

REDEMPTION SCHEDULE
FOR THE DOLLAR COST OF DAI HAN COAL CORPORATION
1963 - 1975

Table No. 11 — Unit = Dollar

| Year | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st Year Loan | 1,817,000 | | | | | | | | | | | | | |
| Installment | | | 227,125 | 227,125 | 227,125 | 227,125 | 227,125 | 227,125 | 227,125 | 227,125 | | | | |
| Interest | | 109,020 | 109,020 | 95,393 | 81,765 | 68,138 | 54,510 | 40,883 | 27,255 | 13,628 | | | | |
| Total | | 109,020 | 336,145 | 322,518 | 308,890 | 295,263 | 281,635 | 268,008 | 254,380 | 240,753 | | | | |
| 2nd Year Loan | | 3034000 | | | | | | | | | | | | |
| Installment | | | | 379,250 | 379,250 | 379,250 | 379,250 | 379,250 | 379,250 | 379,250 | 379,250 | | | |
| Interest | | | 182,040 | 182,040 | 159,285 | 136,530 | 113,775 | 91,020 | 68,265 | 45,510 | 22,755 | | | |
| Total | | | 182,040 | 561,290 | 538,535 | 515,780 | 493,025 | 470,270 | 447,515 | 424,760 | 402,005 | | | |
| 3rd Year Loan | | | 3,203,000 | | | | | | | | | | | |
| Installment | | | | | 400,375 | 400,375 | 400,375 | 400,375 | 400,375 | 400,375 | 400,375 | 400,375 | | |
| Interest | | | | 192,180 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 72,068 | 48,045 | 24,023 | |
| Total | | | | 192,180 | 592,555 | 568,533 | 544,510 | 520,488 | 496,465 | 472,443 | 448,420 | 424,398 | | |
| 4th Year Loan | | | | 803000 | | | | | | | | | | |
| Installment | | | | | | 100,375 | 100,375 | 100,375 | 100,375 | 100,375 | 100,375 | 100,375 | 100,375 | |
| Interest | | | | | 48,180 | 48,180 | 42,158 | 36,135 | 30,113 | 24,090 | 18,068 | 12,045 | 6,023 | |
| Total | | | | | 48,180 | 148,555 | 142,533 | 136,510 | 130,488 | 124,465 | 118,443 | 112,420 | 106,398 | |
| 5th Year Loan | | | | | 402,000 | | | | | | | | | |
| Installment | | | | | | | 50,250 | 50,250 | 50,250 | 50,250 | 50,250 | 50,250 | 50,250 | 50,250 |
| Interest | | | | | | 24,120 | 24,120 | 21,105 | 18,090 | 15,075 | 12,060 | 9,045 | 6,030 | 3,015 |
| Total | | | | | | 24,120 | 74,370 | 71,355 | 68,340 | 65,325 | 62,310 | 59,295 | 56,280 | 53,265 |
| Grand Total | | 109,020 | 518,185 | 1,076,988 | 1,488,160 | 1,552,251 | 1,546,073 | 1,466,631 | 1,397,188 | 1,327,746 | 1,031,178 | 596,113 | 162,678 | 53,265 |

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FINAL DATA NOT AVAILABLE

REDEMPTION SCHEDULE
FOR THE EXISTING LIABILITIES OF DHCC
1962 - 1970

Table No. 12

Unit = Hw 1,000

| Year | Credit Balance | Annual Installment | Interest (8 %) | Total |
|---|---|---|---|---|
| 1962 | 10,601,000 | 1,056,000 | 848,080 | 1,904,080 |
| 1963 | 9,545,000 | 1,943,000 | 763,600 | 2,406,600 |
| 1964 | 7,902,000 | 2,454,000 | 632,160 | 3,086,160 |
| 1965 | 5,448,000 | 2,007,000 | 435,840 | 2,442,840 |
| 1966 | 3,441,000 | 1,325,000 | 275,280 | 1,600,280 |
| 1967 | 2,116,000 | 1,059,000 | 169,280 | 1,228,280 |
| 1968 | 1,057,000 | 473,000 | 84,560 | 557,560 |
| 1969 | 584,000 | 413,000 | 46,720 | 459,720 |
| 1970 | 171,000 | 171,000 | 13,680 | 184,680 |

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FINAL DATA NOT AVAILABLE

REDEMPTION SCHEDULE
FOR THE TOTAL COST OF DHCC
1962 - 1975

Unit = Hw 1,000

Table No. 13

| Year | Dollar Cost | | Existing Liabilities | Total |
|---|---|---|---|---|
| | $ | Hw | | |
| 1962 | - | - | 1,904,080 | 1,904,080 |
| 1963 | 109,020 | 141,726 | 2,406,600 | 2,548,326 |
| 1964 | 518,185 | 673,641 | 3,086,160 | 3,759,801 |
| 1965 | 1,075,988 | 1,398,784 | 2,442,840 | 3,841,724 |
| 1966 | 1,488,160 | 1,934,608 | 1,600,280 | 3,534,888 |
| 1967 | 1,552,251 | 2,017,926 | 1,228,280 | 3,246,206 |
| 1968 | 1,546,073 | 2,009,8 | 557,560 | 2,567,455 |
| 1969 | 1,466,631 | 1,906,620 | 459,720 | 2,366,340 |
| 1970 | 1,397,188 | 1,816,344 | 184,680 | 2,001,024 |
| 1971 | 1,327,746 | 1,726,070 | - | 1,726,070 |
| 1972 | 1,031,178 | 1,340,531 | - | 1,340,531 |
| 1973 | 596,113 | 774,947 | - | 774,947 |
| 1974 | 162,678 | 211,481 | - | 211,481 |
| 1975 | 53,265 | 69,245 | - | 69,245 |

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FINAL DATA NOT AVAILABLE

# REDEMPTION SCHDULE
## FOR DOLLAR COST OF ALL PRIVATE MINES 1963 - 1975

Table No. 14

Unit = Dollar

| Year | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st Year Loan | 3,531,000 | | | | | | | | | | | | | |
| Installment | | | 441375 | 441375 | 441,376 | 441375 | 441,375 | 441,375 | 441375 | 441376 | | | | |
| Interest | | 211860 | 211860 | 185378 | 158895 | 132413 | 105930 | 79,448 | 52965 | 26483 | | | | |
| Total | | 211860 | 653235 | 626753 | 600270 | 573788 | 547305 | 520,823 | 494340 | 467858 | | | | |
| 2nd Year Loan | | 4,461000 | | | | | | | | | | | | |
| Installment | | | | 557,625 | 557,625 | 557,625 | 557,625 | 557,625 | 557625 | 557625 | 557625 | | | |
| Interest | | | 267660 | 267660 | 234203 | 200745 | 167,288 | 133,830 | 100,373 | 66915 | 33458 | | | |
| Total | | | 267660 | 825285 | 791828 | 758370 | 724913 | 691,456 | 657998 | 624540 | 591,083 | | | |
| 3rd Year Loan | | | 11,751000 | | | | | | | | | | | |
| Installment | | | | | [illegible] | [illegible] | [illegible] | 1,468,875 | 1468875 | 1468875 | 1,468875 | 1,468875 | | |
| Interest | | | | 705060 | 705060 | 616928 | 528795 | 440,663 | 352530 | 264398 | 176265 | 88,133 | | |
| Total | | | | 705060 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1,645140 | 1,557008 | | |
| 4th Year Loan | | | | 5532000 | | | | | | | | | | |
| Installment | | | | | | 691,500 | 691,500 | 691,500 | 691500 | 691500 | 691,500 | 691500 | 691500 | |
| Interest | | | | | 331920 | 331920 | 290430 | 248,940 | 207480 | 165960 | 124470 | 82,980 | 41490 | |
| Total | | | | | 331,910 | 1,023,420 | 981,930 | 940,440 | 898,950 | 857,460 | 815,970 | 774480 | 732990 | |
| 5th Year Loan | | | | | 5000000 | | | | | | | | | |
| Installment | | | | | | | 625,000 | 625,000 | 625000 | 625,000 | 625000 | 625000 | 625,000 | 625,000 |
| Interest | | | | | | 300000 | 300000 | 262,500 | 225000 | 187500 | 150000 | 112500 | 75,000 | 37,500 |
| Total | | | | | | 300000 | 925,000 | 887,500 | 850000 | 812500 | 775000 | 737500 | 700,000 | 662,500 |
| Grand Total | | 211860 | 920895 | 2157098 | 3397953 | 4741381 | 5166818 | 4,949,756 | 4722693 | 4495631 | 3827193 | 3063988 | 1432990 | 662,500 |

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REDEMPTION SCHEDULE
FOR THE KWAN COST OF ALL PRIVATE MINES DEVELOPMENT
1963 - 1975

Table No. 15

Unit = 1,000 Kwan

| Year | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st Year Loan | 2,995,500 | | | | | | | | | | | | | |
| Installment | | | 374,813 | 374,812 | 374,813 | 374,812 | 374,813 | 374,812 | 374,813 | 374,812 | | | | |
| Interest | | 239,880 | 239,880 | 209,895 | 179,910 | 149,925 | 119,940 | 89,955 | 59,970 | 29,985 | | | | |
| Total | | 239,880 | 614,793 | 584,607 | 554,723 | 524,737 | 494,753 | 464,767 | 434,783 | 404,797 | | | | |
| 2nd Year Loan | | 3,804,500 | | | | | | | | | | | | |
| Installment | | | | 475,563 | 475,562 | 475,563 | 475,562 | 475,563 | 475,562 | 475,563 | 475,562 | | | |
| Interest | | | 304,360 | 304,360 | 266,315 | 228,270 | 190,225 | 152,180 | 114,135 | 76,090 | 38,045 | | | |
| Total | | | 304,360 | 779,923 | 741,877 | 703,833 | 665,787 | 627,743 | 589,697 | 551,653 | 513,607 | | | |
| 3rd Year Loan | | | 10,052,500 | | | | | | | | | | | |
| Installment | | | | | 1,256,563 | 1,256,562 | 1,256,563 | 1,256,562 | 1,256,563 | 1,256,562 | 1,256,563 | 1,256,562 | | |
| Interest | | | | 804,200 | 804,200 | 703,675 | 602,150 | 502,625 | 401,100 | 301,050 | 201,050 | 100,525 | | |
| Total | | | | 804,200 | 2,060,763 | 1,960,237 | 1,859,713 | 1,758,687 | 1,658,663 | 1,558,137 | 1,457,613 | 1,357,087 | | |
| 4th Year Loan | | | | 4,748,000 | | | 5 | | | | | | | |
| Installment | | | | | | 593,500 | 593,500 | 593,500 | 593,500 | 593,500 | 593,500 | 593,500 | 593,500 | |
| Interest | | | | | 379,840 | 379,840 | 332,360 | 284,880 | 237,400 | 189,920 | 142,440 | 94,960 | 47,480 | |
| Total | | | | | 379,840 | 973,340 | 925,860 | 878,380 | 830,900 | 783,420 | 735,940 | 688,460 | 640,980 | |
| 5th Year Loan | | | | | 4,300,000 | | | | | | | | | |
| Installment | | | | | | | 537,500 | 537,500 | 537,500 | 537,500 | 537,500 | 537,500 | 537,500 | 537,500 |
| Interest | | | | | | 344,000 | 344,000 | 301,000 | 258,000 | 215,000 | 172,000 | 129,000 | 86,000 | 43,000 |
| Total | | | | | | 344,000 | 981,500 | 838,000 | 795,500 | 752,500 | 709,500 | 666,500 | 623,500 | 580,500 |
| Grand Total | | 239,880 | 919,153 | 2,168,730 | 3,737,203 | 4,506,147 | 4,927,613 | 4,568,077 | 4,309,543 | 4,050,507 | 3,417,660 | 2,712,047 | 1,264,480 | 580,500 |

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REDEMPTION SCHEDULE
FOR THE TOTAL COST OF ALL PRIVATE MINES
1963 - 1975

Unit = Hw 1,000

Table No. 16

| Year | Dollar Cost | | Hwan Cost | Total |
|---|---|---|---|---|
| | $ | Hw | | |
| 1963 | 211,860 | 275,418 | 239,880 | 515,298 |
| 1964 | 920,895 | 1,197,161 | 919,156 | 2,116,317 |
| 1965 | 2,157,098 | 2,804,227 | 2,168,830 | 4,972,957 |
| 1966 | 3,897,953 | 5,067,339 | 3,737,203 | 8,804,542 |
| 1967 | 4,741,381 | 6,163,795 | 4,506,147 | 10,669,942 |
| 1968 | 5,166,818 | 6,716,863 | 4,927,613 | 11,644,476 |
| 1969 | 4,949,756 | 6,434,683 | 4,568,077 | 11,002,760 |
| 1970 | 4,722,693 | 6,139,501 | 4,309,543 | 10,449,044 |
| 1971 | 4,495,631 | 5,844,320 | 4,050,507 | 9,894,827 |
| 1972 | 3,827,193 | 4,975,351 | 3,416,660 | 8,392,011 |
| 1973 | 3,068,988 | 3,989,684 | 2,712,047 | 6,701,731 |
| 1974 | 1,432,990 | 1,862,887 | 1,264,480 | 3,127,367 |
| 1975 | 662,500 | 861,250 | 580,500 | 1,441,750 |

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REDEMPTION SCHEDULE
FOR THE DOLLAR COST OF COAL MINES DEVELOPMENT
1963 - 1975

Table No. 17

| Year | Dollar Cost Redemption | | | Hwan Equivalent | Anthracite Equivalent |
|---|---|---|---|---|---|
| | DHCC | Private Mines | Total | | |
| | $ | $ | $ | 1,000 Hw | Tons |
| 1963 | 109,020 | 311,860 | 420,880 | 417,144 | 32,088 |
| 1964 | 518,185 | 920,895 | 1,439,080 | 1,870,765 | 143,908 |
| 1965 | 1,075,988 | 2,157,098 | 3,233,086 | 4,203,011 | 323,309 |
| 1966 | 1,488,160 | 3,897,963 | 5,386,113 | 7,001,947 | 538,611 |
| 1967 | 1,552,251 | 4,741,381 | 6,293,632 | 8,181,721 | 629,363 |
| 1968 | 1,546,073 | 5,166,818 | 6,712,891 | 8,726,758 | 671,289 |
| 1969 | 1,466,631 | 4,949,756 | 6,416,387 | 8,341,303 | 641,639 |
| 1970 | 1,397,188 | 4,722,693 | 6,119,881 | 7,955,845 | 611,988 |
| 1971 | 1,327,746 | 4,495,631 | 5,823,377 | 7,570,390 | 582,338 |
| 1972 | 1,031,178 | 3,827,193 | 4,858,371 | 6,315,882 | 485,837 |
| 1973 | 596,113 | 3,068,988 | 3,665,101 | 4,764,631 | 366,510 |
| 1974 | 162,678 | 1,432,990 | 1,595,668 | 2,074,368 | 159,567 |
| 1975 | 53,265 | 662,500 | 715,765 | 930,495 | 71,577 |

REDEMPTION SCHEDULE
FOR THE HWAN COST OF COAL MINES DEVELOPMENT
1962 - 1975

Table No. 18 Unit = Hw 1,000

| Year | D.H.C.C. | Private | Total |
|---|---|---|---|
| 1962 | 1,904,080 | BEING REVISED; | 1,904,080 |
| 1963 | 2,406,600 | 239,880 | 2,646,480 |
| 1964 | 3,086,160 | FINAL DATA NOT AVAILABLE 919,163 | 4,005,323 |
| 1965 | 2,442,840 | 2,168,730 | 4,611,570 |
| 1966 | 1,600,280 | 3,737,203 | 5,337,483 |
| 1967 | 1,228,280 | 4,506,147 | 5,734,427 |
| 1968 | 557,560 | 4,927,613 | 5,485,173 |
| 1969 | 459,720 | 4,568,077 | 5,027,797 |
| 1970 | 184,680 | 4,309,543 | 4,494,223 |
| 1971 | - | 4,050,507 | 4,050,507 |
| 1972 | - | 3,416,660 | 3,416,660 |
| 1973 | - | 2,712,047 | 2,712,047 |
| 1974 | - | 1,274,480 | 1,264,480 |
| 1975 | - | 580,500 | 580,500 |

# CHAPTER VI RELATIONSHIP BETWEEN INVESTMENT, COST AND RATE OF RETURN

## CHAPTER VI RELATIONSHIP BETWEEN INVESTMENT, COST & RATE OF RETURN

It is hardly expected to estimate the future profit and loss status for private mines mainly because the most of private mine included in this plan are to be newly developed. Especially, the most of private mines currently operating are small scale mines and with such small scale mines, the future production assigned can not be achieved. Therefore, to eliminate this difficulties, existing small scale mines will have to unify to larger scale mines as mentioned before. Hence, for the purpose of evaluating the relationship between investment, cost and rate of return, the following function is calculated. If, we let the net income per ton be "S", return per ton including the allowance for depreciation be "P" and the cost per ton be "C", then the "S" will be:

$$S = C + P, \text{ or}$$

$$P = \frac{lg + lc}{8} + (ls + M + A) \times B + \frac{R\,(ls + M + A)}{(1 + R)^n - 1}$$

where; lc = Amount of investment by foreign credit per ton.

lg = Amount of investment by Government's loan per ton.

ls = Amount of investment by owner's fund per ton

A = Value of mining rights per ton.

M = Annual operating fund per ton.

B = Annual rate of return per ton.
(Capital investment, mining right and operating fund)

R = Annual interest rate.

n = Life of the mine.

or the "P" will be

$$P = \frac{lg + lc}{8} + (ls + M)\left(B + \frac{R}{(1+R)^n - 1}\right) + A\left(B + \frac{R}{(1+R)^{n-1}}\right)$$

And by the Hoscold's Formula, the value of mining rights per ton, "A", becomes

$$A = \frac{P - \frac{lc + lg}{8}}{B + \frac{R}{(1+R)^n - 1}} - (ls + M) \quad \text{.....(M)}$$

In the above function (M), if we let B = 0.2, R = 0.08, n = 20 years, "T" be the total investment per ton, the coal selling price per ton S = Hw 10,00. lc + lg = $\frac{3}{4}$ T, ls = $\frac{1}{4}$ T, then the (M) becomes as follows because the annual operating fund is assumed to be the cost to produce for 3 month period or M = $\frac{1}{4}$ ( C - P).

$$A = 4.75\ P - 0.672\ T - \tfrac{1}{4}\ S.$$

At present, the "C" is Hw 8,100.- and hence the "P" is Hw 2,000.- If, this rate will keep up in future,

$$A = 6,975 - 0.672\ T \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (M')$$

However, if the "P" becomes to Hw 1,500.- and Hw 1,750.- the function (M') becomes as follows:.

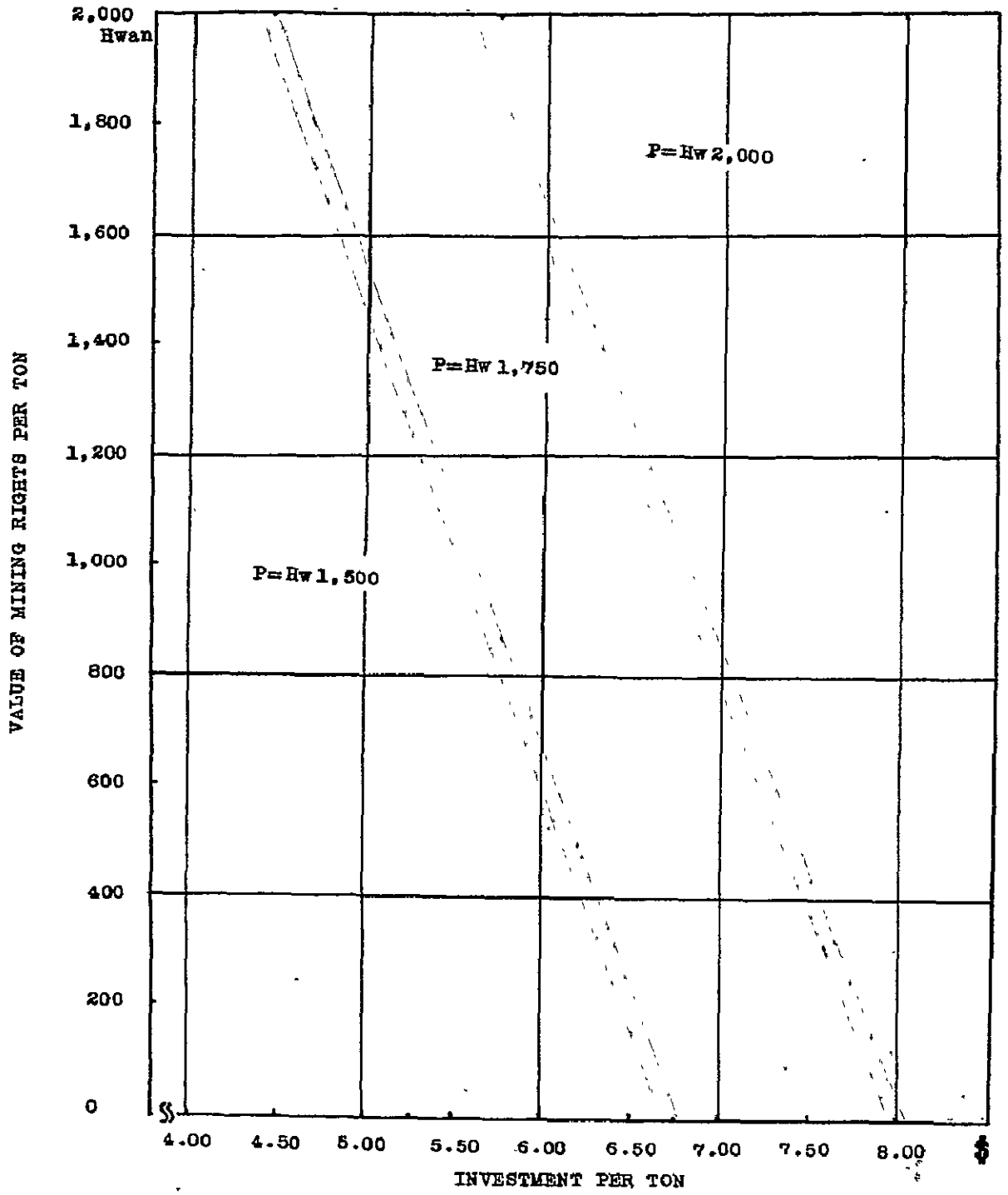
$$A = 4,600 - 0.672\ T \qquad \text{(When } P = 1,500\text{)}$$

$$A = 5,888 - 0.672\ T \qquad \text{(When } P = 1,750\text{)}$$

This function (M') could be graphed as Fig. No. 6. The Fig. No. 6 shows us that the value of mining rights will be zero when the total investment per ton is $ 8.00 or Hw 10,400 and the return per ton P = Hw 2,000. In other words, an investment of $ 8.00 per ton of annual production is the critical limit that as far as the investment could go. Any more investment can not be done unless the cost will be decreased or the "P" will be increased by raising the coal selling price. In this plan, the investment per ton is $7.00 which implies the mining right per ton will be Hw 725 when the return per ton is two thousand hwan.

(Fig. No.6)

# RELATIONSHIP BETWEEN INVESTMANT AND VALUE OF MINING RIGHTS



# CHAPTER VII CONCLUSION

## CHAPTER VII CONCLUSION

We have been described the energy and anthracite required in future, projected plan for an accelerated coal production program, as one of the major steps in creating an expanded industrial base within the Republic of Korea and the supporting projects to achieve the above coal production increasement as well as the financial prospects of Dai Han Coal Corporation and private mines.

As this grand project and the next five-year project come to a realization, three million tons of anthracite could be consumed by various industrial factories and by steam power plants which will be constructed in Jungsun, Samchuck, Bukpyung, Hambaek, and Yongwol. Also each of the Youngam Line and Hambaek Line will serve for the transportation of coal approximately 6 million tons per annum to markets distributed in all parts of the country mainly to Seoul and Inchon area. Additional 2 million tons of coal will be shipped through the port of Mukho to industries in Pusan and Masan area. Altogether, 17 million tons of coal could be consumed every year.

The most of South Korean coal fields are distributed in Samchuck area and the basic rock is formed with limestones. The major portion of powdered anthracite is low grade in the neighborhood of 5,000 K Cal. and therefore the coal must be prepared to

segregate the high and low qualities. That is why, in this area, the power plants must be built to consume these low graded coal and other industries which could use the high quality of anthracite and limestones as the raw materilas or as fuel, should be sited in this area. Hence, immediate survey on geographycal conditions to make this area as the Center of Economic Reformation, has to be done. At the same time, the construction project must be strongly emphasized and possible foreign aid should be arranged.